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2	~~1~~	Design Authority W.J. Powell	W J Powell	3/28/01	S5-13	2	1	C.A. Meldrom	C A Meldrom	3-28-01	R3-72
2	1	Design Agent R.L. Fritz	R L Fritz	11-3-00		3 ~~2~~	1	J.P. Sederburg			R2-50
2	1	Cog. Eng. K.A. White	K A White	11/3/00	R3-47						
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2	1	Safety H. Hughey ~~R.E. DeBusk~~	H T Hughey	3-29-01	S7-07 ~~S7-86~~						
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Project W-521
Waste Feed Delivery System
Advanced Conceptual Design Report
Volumes 1 and 2

K. A. White
CH2MHILL HANFORD GROUP
Richland, WA 99352
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Abstract: This Advanced Conseptual Design Report provides updated technical documentation for the performers of Title I Design for project W-521, Waste Feed Delivery Systems, to assure a smooth initiation of activities, and provides preliminary modifications to the cost estimate for incorporation at the time of the next estimate update.

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ADVANCED CONCEPTUAL DESIGN REPORT FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46

Approved by:

R L Fritz 9-30-00
Mr. Robert L. Fritz

Gregory McLellan 10-4-00
Mr. Gregory McLellan

TABLE OF CONTENTS

Attachments

TABLES

ACRONYMS

ACD	Advanced Conceptual Design
AGA	Alternative Generation and Analysis
CDR	Conceptual Design Report
DOE	U.S. Department of Energy
DST	Double-Shell Tank
HLW	High-Level Waste
LAW	Low Activity Waste
LLCE	Long-Length Contaminated Equipment
MCS	Monitor and Control System
RCS	Retrieval Control System
RPP	River Protection Project
SDD	System Design Description
SST	Single-Shell Tank
TEC	Total Estimated Cost
TFLAN	Tank Farm Local Area Network
TMACS	Tank Monitoring and Control System
TPC	Total Project Cost
WFD	Waste Feed Delivery
WTF	Waste Treatment Facility

ADVANCED CONCEPTUAL DESIGN REPORT FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

1.0 INTRODUCTION

In 1998, the U.S. Department of Energy (DOE) established the River Protection Project (RPP) to retrieve, immobilize, store, and dispose Hanford Site tank wastes. The mission of the Waste Feed Delivery (WFD) Program is a subset of the RPP mission. The WFD Program will reliably deliver the required quantities of tank waste feed to the treatment and immobilization facilities on schedule, within specifications, and in conformance with regulatory, safety, and contractual requirements. The WFD Program has primary responsibility for designing and constructing the facilities that are necessary for waste preparation, waste retrieval, and transfer of low-activity waste (LAW) and high-level waste (HLW) feed to the Waste Treatment Facility (WTF) waste treatment and immobilization facilities. The WFD Program consists of a number of recently completed, ongoing, and planned capital projects that will modify and upgrade the 200 Area Tank Farms and facilities.

Phase 1 WFD, as defined in HNF-SD-WM-SP-012, Revision 1, *Tank Waste Remediation System Operation and Utilization Plan* (Kirkbride et al. 1999), will support the RPP mission by: 1) staging LAW feed, 2) staging HLW feed, 3) supplying this staged feed material to the WTF, 4) receiving various final and intermediate waste products from the WTF, and 5) receiving miscellaneous waste streams. Phase 1 WFD will also make double-shell tank (DST) space available for single-shell tank (SST) waste retrieval. A number of recently completed, ongoing, and planned capital projects will modify and upgrade the 200 Area Tank Farms to accomplish the WFD Phase 1 mission. These capital projects include Project W-211, "Initial Tank Retrieval Systems"; Project W-314, "Tank Farm Restoration and Safe Operations"; and Project W-519, "Tank Waste Remediation System Privatization Phase I." The focus of this report is to refine the cost estimate associated with capital Project W-521 through a series of technical tasks.

The mission of Project W-521 is to upgrade existing systems or provide additional systems and equipment necessary to complete Phase 1 WFD for tanks 241-AW-101, 241-AW-103, 241-AW-104, 241-AY-101, 241-AY-102, 241-SY-101, 241-SY-102, and 241-SY-103. Project W-521 is a subproject of Line Item 94-D-407.

RPP-6333, Revision 0, *Project W-521 Waste Feed Delivery System Conceptual Design Report (CHG 2000a)*, was completed in July 2000, which provided detailed drawings and specifications for accomplishing the scope of Project W-521 as defined in HNF-4408, Revision 1, *Project Definition Criteria for Project W-521*, (CHG 2000b).

Within the CDR, a project estimate for the various sub-activities was provided. This estimate serves as the formal cost baseline for the project, and is what all cost reductions/additions identified in this report will be compared against.

The current CDR estimate for the Total Estimated Cost (TEC) for project management, engineering, long-lead procurement, and construction (including site allocations, escalation, and contingency) is $327,990,000. Expense funded support costs (including escalation and contingency) are $44,320,000. The Total Project Cost (TPC) (including site allocations, escalation, and contingency) is $372,300,000.

A review of Project W-521s Conceptual design was performed. The results of this review were captured in RPP-7196, *Design Review Report for the Project W-521 Conceptual Design.* There are several open items in this report that were to be addressed in the ACDR. A review was to be performed prior to issuing the ACDR to assure all of the open items that were to be addressed in the ACDR were actually fully addressed. However, W-521 is being delayed for several years. To facilitate the restart effort, the ACRD is being issued without this review. Prior to any part of this ACDR being used, a review of the most current revision of RPP-7196 is required to assure all open items for that part have been properly addressed.

2.0 PURPOSE OF ADVANCED CONCEPTUAL DESIGN

During preparation of the CDR, technical and programmatic requirements associated with the WFD Program were rapidly evolving. This resulted in a number of areas where risks were identified from a technical and, ultimately, a cost perspective. An Advanced Conceptual Design (ACD) effort was initiated to:

- Evaluate the impacts of changing technical requirements on the drawings, specifications, etc., and revise the appropriate documentation including the cost estimate,

- Resolve selected uncertainties identified in the CDR, thus allowing reduction of selected contingencies,

- Incorporate selected comments received during Conceptual Design, but not incorporated for various reasons, and

- Explore identified alternatives where cost savings appeared realistic.

This report is the product of the ACD (including the attachments hereto). It provides updated technical documentation for the performers of Title I Design to assure a smooth initiation of activities, and provides preliminary modifications to the cost estimate for incorporation at the time of the next estimate update.

3.0 ADVANCED CONCEPTUAL DESIGN METHODOLOGY

The Request for Proposal and, ultimately, this report, identified a series of 16 specific activities to be performed. Each activity was treated as a stand-alone subtask with an identified scope, schedule, and Lead Engineer. These subtasks all provided technical data for potentially updating the cost estimate and refining scope. Upon completion of each subtask, a brief report was prepared identifying options reviewed and resulting recommendations. These technical reports were reviewed/approved by CH2M HILL Hanford Group, Inc., personnel and appropriate estimate data prepared to support the final update to the cost estimate. Technical and cost information from each completed subtask was then integrated with the overall design package [drawings, estimate, System Design Description (SDDs), etc.]. This report provides the individual task reports, revised summary estimate, revised drawings, and selected other data as attachments. The results of ACD, combined with the CDR, provide a firm basis for initiation of Title I Design.

4.0 TASK DESCRIPTIONS

The DST system has numerous subsystems established within it. Project W-521 will provide upgrades and modifications to the following nine systems for waste preparation, waste retrieval, waste transfer, and process control: 1) Diluent and Flush System, 2) Mixer Pump System, 3) Transfer Pump System, 4) RPP/WTF Transfer Piping System, 5) Piping, Jumper, and Valve System, 6) Retrieval Control System, 7) Valve/Pump Pits and Cover Block System, 8) Electrical/Water Utilities System, and 9) AY/AZ Ventilation System. Various uncertainties remained after completion of the CDR. To resolve these uncertainties, 16 specific tasks were identified, which involved performing additional analysis and reviews and then determining if any of these enhancements will have an effect on the project cost and schedule. A summary description of each task follows (including technical results and cost summaries).

4.1 Valve Type Analysis

4.1.1 Scope

This task investigates various configuration options for the two-way and three-way valves to be installed in the process pits by Project W-521.

The current concept is to use readily available valves equivalent to those being used by Projects W-211 and W-314. There have been issues raised with these valves, however, regarding the operability and reliability in the tank farm environment. This task evaluates available valves and makes recommendations as to the most appropriate valve for use, configuration of valves, and additional testing to arrive at an optimum system.

The main activities performed during the Valve Type Analysis were:

- Preparing a list of pertinent valve functions and requirements.
- Contacting various valve vendors for information relative to their product being able to meet the requirements.
- Reviewing other sources for pertinent documentation such as commercial nuclear facilities, other DOE projects, and published reports.
- Reviewing available data on material responses to radiation fields.
- Preparing a test and evaluation plan for this activity.
- Establishing a small test program at a vendor's facility.

4.1.2 Technical Results

The ACD schedule did not allow enough time for a detailed evaluation of various valve types. This task, however, completed the preparation of a procurement specification and test plan to support detailed testing of two- and three-way valves at the start of Definitive Design. From discussions with various vendors, it appears that the concerns that initiated this analysis (i.e., leaking stems and seats; high torques) can be eliminated.

In addition, this analysis determined that using the three-way valves in the process pits was recommended over using all two-way valves. The primary reasons for this recommendation were the concerns with waste buildup in the dead leg pockets created by using all two-way valves, and the complex pit arrangements that this option creates. See Attachment A for details.

4.1.3 Cost Summary

The recommendation to stay with all three-way valves will have no cost change impact to the CDR estimate; however, if testing of the valves during Definitive Design shows that the gear operators can be eliminated on the two-way valves in the valve pits, this will have a cost savings of approximately $1,546,000. It is highly likely that this will be acceptable, and the reduction of $1,546,000 can be achieved.

4.2 Mixer Pump Impingement Force on In-Tank Equipment

This task evaluates the impingement forces imposed on in-tank equipment during mixer pump operations. The assumptions that were made during the CDR phase can now be confirmed based upon data from recently completed tests.

Activities involved with this task included:

- Reviewing the existing analyses.
- Researching existing and planned component locations and configurations.
- Estimating the acceptable forces on the components.
- Calculating the expected forces on the components.
- Preparing an evaluation report.

4.2.1 Technical Results

The results of this evaluation include confirmation that there are no impingement force concerns in AW, and that selected components should be removed from tanks in 241-AY and 241-SY farms. Certain operational controls will also be required in AY tanks. See Attachment B for details.

4.2.2 Cost Summary

The cost changes associated with this task have all been incorporated in the related Task 12, LLCE Component Evaluation (see Attachment L to this report).

4.3 Heating, Ventilation, and Air Conditioning Scope Refinements

This task reviews the scope and design approach used for the 241-AY and 241-AZ ventilation systems. This task determined if there was a more cost-effective manner in which to accomplish portions of this work.

The key activities involved with this task are shown below.

- During Conceptual Design activities, a regulatory interpretation recommended installing a fully redundant secondary train in the primary ventilation system. This revision was captured in the CDR. This task assesses the reliability of the primary ventilation system relative to its ability to support waste transfer to the WTF and recommends the minimum upgrades to achieve the goal. This task includes performing a cost-to-benefit analysis of incrementally reducing the number of redundant components contained in the Conceptual Design.

- The Conceptual Design includes a new catch tank and lift station that will transfer ventilation condensate to the 241-AY and 241-AZ tanks. This task considers options for reducing the cost of this design.

- The Level 2 Specification for ventilation requires that the 241-AY and 241-AZ annulus ventilation systems provide a minimum of 850 CFM through the annulus slots of each tank. The existing 241-AY and 241-AZ annulus ventilation systems do not comply with this. This task considered several options to achieve the require flow rate. The task develops cost estimates for implementing the preferred option.

- This task reviews the ventilation design shown in the CDR and compares the modifications with the requirements of the Level 2 Specification for Ventilation.

4.3.1 Technical Results

The results of each of the four activities are:

- The cost-to-benefit analysis concluded that modifications contained in the CDR are unnecessary. Rather, the potential of system failure can be sufficiently mitigated through the practice of increased maintenance during DST pre-transfer operations.

- Rather than installing a new lift station, this activity recommended installing a pump in the 241-A-702 seal pot. This approach is much more cost-effective than installing a new lift station.

- The activity revealed that the 241-AY and 241-AZ annulus ventilation systems should be modified to achieve the higher flow rate. The modifications should add a supply fan to each of the existing annulus ventilation systems.

- The activity concluded that the Conceptual Design complies with the Level 2 Specification for ventilation.

Detailed information is provided in Attachment C.

4.3.2 Cost Summary

A total reduction of more that $8 million from the CDR estimate results from implementing these recommendations. A final decision on implementation is expected from CHG prior to initiation of Definitive Design.

4.4 Refine 241-AZ-151 Decommissioning

This task reviewed and refined the approach used for the 241-AZ-151 decommissioning to determine if there is a more cost-effective manner in which to accomplish this work.

Activities involved with this task included:

- Reviewing applicable regulations for decommissioning the tank.

- Evaluating how the tank can be decommissioned and compared various methods of accomplishing the decommissioning.

- Preparing an Alternative Generation Analysis (AGA) report that documents the preferred method of decommissioning the catch tank.

4.4.1 Technical Results

The recommendation are as follows:

- Stabilize the tank by pumping tank liquid and removing tank equipment,

- Isolate the tank by cutting and capping the inactive incoming lines at the tank and rerouting the active process condensate line, and

- Monitor the tank by utilizing and the existing ENRAF monitoring system.

The combination of these recommendations would result in successful initial decommissioning. See Attachment D for details.

4.4.2 Cost Summary

The recommended approach to decommissioning this catch tank is consistent with the concept proposal in the CDR (with minor variations). No change to the cost baseline will result from this task.

4.5 Comparison of Fuel Oil Boiler to Electric Heating System

This task investigated the use of an electrical water heater for the 241-AW diluent and flush system versus the CDR approach, which utilized a fuel oil boiler, to determine the most appropriate method of heating. The review considered all new or revised requirements from the Level 2 Specifications and incorporated the new data available from electrical loading calculations, etc.

Activities involved with this task included:

- Determining the requirements for diluent and flush water heating.
- Determining ranking criteria.
- Ranking electric heating versus fuel oil heating.
- Preparing an AGA report.

4.5.1 Technical Results

The recommendation are to install additional electric heating capabilities in the SY diluent system, and redesign the AW diluent system from a fuel oil fired boiler to an electric system. Several deviations/changes to the Level 2 Specification must be made, as well as changes to transformer sizes, etc. See Attachment E for details.

4.5.2 Cost Summary

A reduction of approximately $71,000 will result from this task.

4.6 Optimize the Caustic Diluent Pad Design to Minimize the Accumulation of Water

This task consisted of refining the design for the caustic diluent system pad and sump to minimize the accumulation of water and miscellaneous debris within the sump and provide for easy removal of these items from the sump. This will help keep the system in a more operable condition and will minimize the generation of unnecessary waste.

Alternatives that were considered included:

- Use of a roof over the pad and sump area.
- Modifications to the containment structure.
- Lighting options.
- Waste removal systems.

4.6.1 Technical Results

The reconfigured pad (including a shelter) provides a more compact and operationally friendly layout for accommodating the revised heating approach explained in Attachment E and for providing regulatory compliance and risk reduction. See Attachment F for details.

4.6.2 Cost Summary

An increase of approximately $417,000 initial cost will result from this task. This increase, however, is warranted when the operator improvements and minimization of waste are considered. The proposed redesign also reduces risks in the SY Farm, although no reduction in contingency has been applied.

4.7 Mixer Pump Analysis to Support Procurement Specification Preparation

This task involved evaluation of criteria and certain critical parameters associated with the Project W-521 CDR procurement specifications that may affect the original CDR content, estimate and schedule. Specifications potentially affected include the Mixer Pump, Transfer Pump, and In-tank Camera specifications.

Activities involved with this task included:

- Researching past tank mixing results from all available sources, such as Project W-151, "Tank 241-AZ-101 Mixer Pumps," Savannah River, Oak Ridge, etc., to determine whether lower horsepower mixer pumps or a fewer number of mixer pumps can be utilized to effectively mix tank waste.
- Determining changes required in the specifications (and other affected documents) due to 90 percent CDR review comments.
- Evaluating schedule coordination of procurement and construction activities.
- Incorporating changes due to release of the Level 2 Specifications and the results of ACD subtask analyses for the subject systems/components.

4.7.1 Technical Results

The recommendation is to continue the approach of installing two mixer pumps in all tanks within the Project W-521 scope. This includes reducing the number of pumps in Tanks AY-101 and AY-102 from 4, 150 hp pumps in each tank to 2 reduced diameter, 300 hp pumps in each tank. The mixer pump procurement specification was revised to include the evaluation results, the Level 2 Specification changes, and to make the document consistent with current RPP reporting format. Only the mixer pump specification required revision as a result of the ACD effort. Attachment G contains the evaluation report and the revised specification.

Note that Task 2, (Attachment B) Mixer Pump Impingement Force on In-Tank Equipment supplied key input to this task.

4.7.2 Cost Summary

A total reduction of more than $11.7 million from the CDR estimate results from implementing these recommendations. A final decision on implementation is expected from CHG prior to initiation of definitive design.

4.8 Survey of Transfer Route

This task evaluated the route chosen for the transfer lines between the new 241-AP-A valve pit and the WTF during Conceptual Design to confirm that it is the optimal path.

The main focus of this task was to perform a preliminary route survey of the corridor chosen during the Conceptual Design phase. Prior to performing this route survey, additional field walks and reviews of historical drawings were performed to determine if any interferences exist. HNF-5371, Revision 1, *Site Development Plan For Project W-521, Waste Feed Delivery Systems* (CHG 2000c), was reviewed for any useful information. Obstructions or inconsistencies found by the route survey will be investigated by use of potholing, ground-penetrating radar scans, and further document searches.

The preliminary route survey was used to:

- Find the optimum combination of alignment and grades along the chosen route,
- Avoid any existing physical obstructions, including wells and the 216-A-29 ditch and
- Prepare an accurate estimate of earthwork quantities.

4.8.1 Technical Results

(Awaiting resolution of interface issue with WTF.) See Attachment H for details.

4.8.2 Cost Summary

No changes to the cost baseline have currently been identified. If, however, the tie-in coordinates are relocated as proposed, approximately $400,000 can be removed from the Project W-521 estimate due to reduction in piping lengths.

4.9 Distribution of Mixer Pump Power

This activity investigated options for providing electrical power to the new mixer and transfer pumps being installed by Projects W-211 and W-521.

Activities involved within this task included:

- Investigating various power distribution alternatives.
- Assuring that the selected alternative met the new Level 2 Specification requirements.
- Evaluating the flexibility of the alternative with respect to schedule.
- Assuring that the required components were commercially available.

4.9.1 Technical Results

The results proposed a more flexible system consisting of a centrally located power island with power distribution to the various loads. This system is not significantly dependent upon the construction sequencing of the farms, which lowers the direct cost slightly while eliminating risk. See Attachment I for details.

4.9.2 Cost Summary

This task resulted in an overall reduction of approximately $142,000 from the CDR estimate.

4.10 Vendor Search for Small Camera System

The task performed an evaluation of various alternatives available for a small camera system to be utilized within the tanks, preferably utilizing 4-in. risers.

In-tank viewing is required during WFD operations. Project W-521 will install a camera in all of the DSTs within the scope of the project, which would include tanks SY-101-102-103, AW-101-103-104, and AY-101-102.

Cameras will be used to lower equipment into the tank, estimate deflection due to mixer pump forces, view in-tank equipment, view waste, etc.

In-tank cameras are used extensively at the Hanford Site, and there is a significant amount of experiences, interests, and opinions that can be used as to assist us in making a decision on the best method for in-tank viewing.

Key activities performed during this task were:

- Determining and documenting the requirements for in-tank viewing applicable to WFD. The bases and requirements for in-tank viewing were listed for future incorporation into the RCS SDD. The requirements primarily came from the Level 2 Specifications for DST monitor and control system subsystem and the process control strategy for WFD. This work was coordinated with Operations to understand the durations required for in-tank viewing.

- Gathering and organizing Hanford in-tank camera related data/information that is relevant to WFD.

- Conducting a vendor search for camera alternatives utilizing data from other nuclear facilities and other vendor indexes/sources.

- Evaluating alternatives from a cost, operability, and useful lifetime perspective to support camera system selection.

4.10.1 Technical Results

The results of this task indicate that it is unlikely at this time that a commercially available camera system is obtainable which meets all requirements/needs. The recommendation is to continue to use a permanent camera installation (4-in. where no 12-in. risers are available and 12-in. where possible). It is possible that evolution of technology may make other options available. See Attachment J for details.

4.10.2 Cost Summary

The recommended approach is consistent with the original approached developed in the CDR. There are no cost changes to the CDR baseline resulting from this task.

4.11 Evaluate Performance of Instrumentation

This task involved the review and analysis of the performance characteristics of instrumentation used in the AZ-101 mixer pump test, SY-101 waste transfer, and C-106 transfer and how this data could be used to optimize Project W-521 design.

Key elements of this activity included:

- Gathering data pertinent to waste transfer instrumentation.

- Determining the instrumentation requirements for material balance and density measurements used in the most recent waste transfers at Hanford.

- Determining whether other commercially available alternate technologies meet the requirements.

4.11.1 Technical Results

At any time during the mixing operation, the process could be operated in the recirculation mode, and the in-line density could be recorded respective to the pump suction position. Further analysis is required to determine if this would provide valuable data to the WFD operation.

Project W-521 RCS should connect the insulating concrete thermocouples. This will provide additional data that will be helpful in determining sludge mobilization.

The instrumentation that indicates the position of the mixer pump needs to be calibrated or biased before put in use in the tanks. This should be stated as a capability of the instrumentation and as installation criteria. See Attachment K for details.

4.11.2 Cost Summary

The cost changes associated with the results of this task have been incorporated into the subtask on existing instrumentation interface (see Attachment N or this report).

4.12 Reuse of Long-Length Contaminated Equipment Components

This task evaluated the Long-Length Contaminated Equipment (LLCE) system in an effort to minimize the amount of consumable material and, hence, the cost, associated with removing LLCE.

Key activities performed within this task included:

- Confirming the LLCE to be Removed – The LLCE equipment listed for removal in the Project W-521 CDR Outline Specification, Section 200, Table CS-1, was verified, including accounting of results from Task 2, Impingement Forces

- Researching Pit/Riser Configuration – For the LLCE identified for removal, the configuration of the associated pit and riser was documented. This information was obtained from applicable drawings and previous pit/riser surveys.

- Determining Method of Removal/Disposal – Small diameter LLCE (i.e., instrument trees, air lances, etc.) can be removed without the use of the LLCE system. The LLCE identified for removal were evaluated to determine the most cost-efficient removal method.

- Determining LLCE System Component Inventory – Based on the LLCE removal list, a list of LLCE system components needed for the removal of the identified LLCE was compiled. Several LLCE system components have already been designed and fabricated. This existing inventory was documented.

- Evaluating LLCE System – The LLCE system utilizes several items that are considered "consumable" and will be disposed of with the LLCE being removed. In addition, the CDR concept required that a unique adapter and platform be developed for each pit type/size where LLCE removal is required. It is highly possible that with some modifications, reuse of much of this material can be achieved. Consumable items that are associated with high procurement or fabrication costs will receive priority.

- Determining Changes – Based on the results of the LLCE system evaluation, changes to the design and/or the operating methodology were proposed. Sketches and/or narratives describing the proposed changes were developed.

- Estimating Cost of Proposed Changes – The cost to implement each of the proposed changes was estimated. The implementation cost was then compared to the expected savings in operating costs. This information was used to determine if the proposed changes are economically viable.

- Revising CDR Documents – The proposed changes to the LLCE system were incorporated into the appropriate CDR documents.

4.12.1 Technical Results

The results of this subtask included a reduction in the number of LLCE retrieval and disposal system infrastructure components needed by the project and reduction in the number of items that require disposal using the LLCE system (as opposed to less expensive burial box disposal). See Attachment L for details.

4.12.2 Cost Summary

The cost reduction to the CDR estimate associated with this task is approximately $15.38 million.

4.13 Double-Shell Tank Monitor and Control Subsystem Improvement

This task involved reviewing existing requirements for interfacing with the Tank Farm Local Area Network (TFLAN), refining these requirements, and applying these refinements to the Project W-521 design.

Activities performed as part of this task included:

- Reviewing Level 2 Specification for the DST Monitor and Control Subsystem.

- Reviewing ISA Standards for applicability to the DST Monitor and Control Subsystem.
- Refining DST Monitoring and Control TFLAN interface requirements.

4.13.1 Technical Results

A long-range plan is required that specifically defines the roles and responsibilities for each project that provides a piece of the RPP monitor and control system.

The monitor and control systems are made up of existing and new systems. The duration and schedules of the projects that make up the monitor and control systems encompass several years. The plan should cover system architecture, design philosophy, safety classification, operational requirements, maintenance requirements, network administration, configuration management, and change control.

It is recommended that monitor and control system hardware and software be standardized. This will maximize the ability to simplify implement integration and consolidation of system functions for WFD. Specific to Project W-521, it is recommended that additional monitoring, control, and interfaces be provided at various components (see Attachment M for details).

Utilize the existing TFLAN infrastructure and extend TFLAN to new ICE Buildings.

4.13.2 Cost Summary

The impact to the Project W-521 cost estimate is an increase of approximately $441,000. There are other short-term costs associated with the generic recommendations noted above, however, the overall program costs will ultimately decrease.

4.14 Existing Instrumentation Interface Refinement

This task reviewed the requirements for interfaces with existing instrumentation, provided further definition to these requirements and applied these findings to the Project W-521 design. It determined the interface requirements between DST Monitor and Control Subsystem and the following instrumentation as applicable to WFD: tank waste level, tank dome space pressure, in-tank gas analysis, selected ventilation parameters, and waste and structure temperatures.

Activities performed as part of this task included:

- Reviewing new Level 2 Specification for DST Monitor and Control Subsystem.
- Further refining the interfaces with existing instrumentation.

- Working with other projects, such as Project W-314, to further define project interfaces and responsibilities.

- Completing a field walk down to determine technical complexity and cost of tying into existing instrumentation.

4.14.1 Technical Results

This evaluation documented the existing instruments that are required to be monitored by the Project W-521 RCS, and identified the current configuration of the instrumentation. Data will be received by the RCS from TMACS via TFLAN or signals will be connected directly to the RCS.

One important consideration is that TMACS is classified as safety-significant and TFLAN is general service. Safety-significant functions must remain with TMACS.

For existing instrumentation connected to TMACS: There are two methods identified in the evaluation that will allow the RCS to receive data. The first method assumes that an interface between TMACS and TFLAN is established. It was assumed in the evaluation that the Central Monitoring System Project would provide this interface. The TMACS/TFLAN interface would allow the Project W-521 RCS to read data that is connected to TMACS via a TFLAN connection. The second method involves modifying existing signals connected to TMACS. The existing signals would be connected to TMACS and the Project W-521 RCS. This method would not require a TMACS/TFLAN interface.

The method of interfacing will be determined in Detailed Design. See Attachment N for details.

4.14.2 Cost Summary

The results of this task (including information from Task 11, Evaluation of Existing Information, requires an increase of approximately $741,000 from the CDR estimate.

4.15 Portable Pit Decontamination Unit

This task evaluated improved remote handling techniques for pit operations, including pit decontamination and crack repair.

The concepts currently reflected in the CDR are to build temporary greenhouses for each pit entry/work package execution. The cost to build/tear down these greenhouses and the associated waste generated is excessive. A portable, re-useable decontamination unit offers the potential for cost reduction, waste minimization, and schedule improvement by reducing radiation exposure and manpower-intensive activities in the pits.

Specific activities performed as part of this task included:

- Reviewing recent studies that evaluated alternative methods of completing pit operations remotely. The purpose of this review was to understand the solutions that have been proposed, the basis for the identification and selection of those solutions, and the scope of work those selected solutions are intended to address.

- Identifying the full scope of tasks that must be completed under the general scope of pit operations and listing the requirements and desired goals associated with those tasks.

- Determining the personnel dose rate, cost and schedule impacts attributable to each task. This activity sets the stage for evaluating the potential benefit of upgrading a particular task to be accomplished by remote methods.

- Identifying the logical break points based upon life-cycle cost, dose, and schedule considerations that represent significant improvement opportunities.

- Through the AGA process, identified concept options that address each of the logical break points. A preferred concept was selected based upon an evaluation that examined each option's ability to meet stated requirements and how well specified goals were met (desirable characteristics).

- A subtask within this task was to evaluate options for the repair of cracks found in the pump and valve pits. The requirements and desired characteristics were identified and then a preferred concept was selected through decision analysis.

4.15.1 Technical Results

A recommendation to revise the planning process from entirely manual to a combination manual and use of a remote arm mounted to a backhoe resulted from this task. See Attachment O for details.

4.15.2 Cost Summary

The cost reduction to the CDR estimate as a result of this task if approximately $8.2 million.

4.16 Diluent System Piping Tie-Ins Refinement

This task investigated options for routing diluent to the mixer and transfer pumps to be installed by Project W-521.

The current concept is to utilize existing 2-in. slurry lines that feed the central pump pits. The existing line will be tied into to add above-grade valves and additional pipe to provide the option of feeding either the mixer pumps or the transfer pump. However, these existing lines are highly contaminated and it is possible that a less costly method may be available. This task evaluated available options and makes a recommendation as to the most appropriate way to route diluent to these pumps.

Activities performed during this task included:

- Determining diluent system interface requirements.
- Developing other feasible options for evaluation.
- Evaluating the different options from a cost and technical perspective.
- Modifying design media based on preferred option.

4.16.1 Technical Results

Instead of tying into the existing slurry lines, this analysis recommended that separate 3-in. diluent lines be run to each of the SY DSTs from a tie-in to the existing farm service water line. The primary reasons for this recommendation were to support the requirement to feed raw water and/or diluent to the mixer pumps at a flow rate of 200 gpm and to eliminate the need to tie-in to contaminated existing slurry lines. See Attachment P for details.

4.16.2 Cost Summary

The recommendation to run separate lines will have a reduction in cost of approximately $57,000 to the CDR estimate. Although additional piping is required, this option is lower in cost since the tie-ins to the existing slurry lines would be eliminated. In addition, there is no additional cost for trenching since the new diluent lines would share trenching with the new waste transfer and/or electrical lines being installed in the farm.

5.0 OTHER DOCUMENTATION

The other documents prepared during the ACD are as follows:

- Updating of all drawings that were changed as a result of the ACD effort. A complete set of these drawings showing the primary changes from the CDR, Rev. 0 Baseline is contained in Attachment R.
- Updating of all of the SDDs was performed. The primary drivers for updating the SDDs were the issuance of revisions to the Level 2 Specifications. Additional input was provided by the Design Authorities, several of the alternative analyses included as part of this report, GAP Analysis furnished by client personnel, and scope changes driven by the previously discussed tasks.
- Updating of the Summary Project Cost Estimate has been completed in accordance with the recommendations contained herein. The detailed work elements have not been updated, but will be completed design contract data are incorporating early in Title I Design.
- Interface Control Drawings have been updated in accordance with the recommendations contained in this report, however, they are not included in this document but are maintained in project files.

6.0 SUMMARY OF RESULTS

6.1 Technical Summary

As a result of these activities, technical risk has been significantly reduced. Specific areas where the ACD provided major improvements to the technical baseline (thus lowering risk) are:

- Incorporation of current Level 2 Specification requirements (or, conversely, identifying waivers/exceptions necessary to support the initiation of Title I Design).
- Incorporation of new safety analysis results.
- Reduction in uncertainties associated with removal of LLCE.
- Improvements in procurement documentation for mixer/ pumps.
- Resolution of outstanding comments from the CDR.
- Elimination of the fuel oil fired boiler for the diluent system.
- Minimization of the ventilation upgrades while still addressing issues.
- Establishment of a firm approach for taking the AZ-151 collection tank out of service.
- Identification of a more detailed instrumentation strategy.
- Updating of the technical support documentation necessary to smoothly transition into Title I Design (Master Equipment List, SDDs, drawings, specifications, etc.).
- Improvements/refinements identified that will result in a lower cost and lower risk entrance into the subsequent phases of the project.

6.2 Cost Summary

A summary by task is shown in Table 6-1.

Each individual task shows the direct cost increase/reduction associated with the recommended approach.

Table 6-1. Task Summary.

Task No.	Task Title	Cost Increase	Cost Reduction
1.	Valve Type Analysis		$1,545,521
2.	Mixer Pump Impingement Force on In-Tank Equipment		Included in Task #12
3.	HVAC Scope Refinements		
3a.	Condensate		$2,753,693
3b.	Annulus	$4,107,317	
3c.	AGA		$9,735,876
4.	Refine 241-AZ-151 Decommissioning		
5.	Comparison of Fuel Oil Boiler to Electric Heating System		$71,128
6.	Optimize the Caustic Diluent Pad Design to Minimize the Accumulation of Water	$417,842	
7.	Mixer Pump Analysis to Support Procurement Specification Preparation		$11,721,804
8.	Survey of Transfer Route		
9.	Distribution of Mixer Pump Power		$141,733
10.	Vendor Search for Small Camera System		
11.	*Evaluate performance of Instrumentation*		
12.	Reuse of LLCE Components		$15,380,108
13.	DST Monitor and Control Subsystem Improvements	$440,927	
14.	Existing Instrumentation Interface Refinements	$740,005	
15.	Portable Pit Decontamination Unit		$8,280,905
16.	Diluent Piping Tie-Ins Refinement		$57,408
TOTAL		**$5,706,091**	**$49,688,176**
NET COST SAVINGS*			**$43,982,085**

*Note that not all recommendations have been approved by CHG, nor have any reevaluations of contingency percentages been performed.

Attachment Q contains revised cost estimate summary sheets that incorporate these results and show the trended estimate resulting from the ACD effort.

7.0 REFERENCES

CHG 2000a, *Project W-521 Waste Feed Delivery System Conceptual Design Report*, RPP-6333, Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

CHG 2000b, *Project Definition Criteria for Project W-521*, HNF-4408, Revision 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

CHG 2000c, *Site Development Plan For Project W-521, Waste Feed Delivery Systems*, HNF-5371, Revision 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

Kirkbride, R.A., Allen, G.K., Certa, P.J., Manuel, A.F., Orem, R.M., Shelton, L.W., Slaathaug, E.J., Wittman, R.S. (NHC), and MacLean, G.T. and Penwell, D.L. (SESC), 1999, *Tank Waste Remediation System Operation and Utilization Plan*, HNF-SD-WM-SP-012, Revision 1, Numatec Hanford Corporation, Richland, Washington.

Attachment A

Attachment A

Valve Type Analysis

VALVE TYPE ANALYSIS

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-006
ACDR Subtask 1
Revision 0

September 2000

prepared by

The HND Team

VALVE TYPE ANALYSIS

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46
Report No. 990920203-006
ACDR Subtask 1
Revision 0

September 2000

Prepared by: Tom Salzano, P.E.

Approved by: R J Fritz
Robert Fritz

Date: 9-29-00

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Acronyms

ACD	Advanced Conceptual Design
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
CDR	Conceptual Design Report

1.0 INTRODUCTION

Project W-521, Waste Feed Delivery System Project, is upgrading the process pit jumper arrangements in the following pits: Pump Pits 241-AW-01A, -02A, -03A, -04A; 241-AY-01A, -02A; 241-SY-01A, -02A, -03A; and Valve Pits 241-AP, 241-AP-A; 241-SY-A, -B. The jumper arrangements consist of a number of two-way and three-way valves to achieve the various routing objectives in each of the process pits. During the conceptual design of Project W-521 the valve selection was based on readily available valves equivalent to those being used by Projects W-211 and W-314. Based on issues that have been raised on the performance of these valves, a Valve Type Analysis task was identified for the Project W-521 Advanced Conceptual Design (ACD).

1.1 Purpose

The purpose of this ACD Task was to investigate options for the two-way and three-way valves. The task was divided into the following two subtasks:

- Subtask 1 - Test and Evaluation, and
- Subtask 2 - Two-Way Valve Investigation.

The primary task of the Subtask 1 was to develop a test plan to find possible vendors to provide 3-in. three-way ball valves that can meet the Project W-521 valving requirements. The primary task of Subtask 2 was to determine if it was both technically possible and financially warranted to use all two-way valves.

1.2 Scope

The scope of Subtask 1, Test and Evaluation, consisted in the development of a procurement specification for the test valves and a valve test plan. The scope of Subtask 2, Two-Way Valve Investigation consisted of modifying the process pit jumper arrangements to determine if the use of all two-way valves was possible. An estimate was then performed to determine if it was cost effective to switch to two-way valves.

2.0 METHODOLOGY

The process followed in Subtask 1 consisted of a review of pertinent literature, including the *Double-Shell Tank Transfer Valving Subsystem Specification*, HNF-4163, and contacts with vendors for the supply and testing of the valves. The process followed in Subtask 2 consisted in the layout of new jumper arrangements for the process pits affected. This was backed up with a cost estimate to determine if the elimination of the three-way valves was warranted.

3.0 ASSUMPTION

For Subtask 1, the following assumptions were made:

1. The total lifetime accumulated dose for the valve seats and seals is 6×10^7 Rad. This was taken from the design requirements for Project W-314 that was based on an earlier analysis from the Cross-Site Transfer System Project. The valving specification, HNF-4160, references HNF-2004 for the induced radiation environment for the valves, however, no total dose is provided. It is believed that the total dose would be lower by no more than a factor of four and since this would not drive the seat or seal material, a detailed analysis using the new source terms in HNF-2004 was not warranted.

2. The test plan would only address the concerns with stem leakage, seal leakage, and torque.

For Subtask 2, the following assumptions were made:

1. The quantity of jumpers in each pit will remain unchanged.

2. Manual three-way valves will still be used on the drain jumpers.

4.0 DISCUSSION

4.1 Subtask 1 - Evaluation and Test

As stated earlier, the purpose of this subtask was to identify vendors that could supply 3-in. three-way ball valves capable of meeting the Project W-521 requirements. A typical cross-section of a three-way valve is shown in Figure 4-1. The test plan was developed to address the three primary issues that were identified during the testing of valves for Project W-211 and W-314:

1. Leakage from the stem packing,

2. Leak by on the valve seats, and

3. High operating torques.

The first tasked involved in the evaluation and test of the valves was to develop a list of pertinent valve functions and requirements. The bulk of the functions and requirements were derived from the Level 2 valving specification (HNF-4160) and from Project W-314 requirements (W-314-P1). With these requirements identified, a performance procurement specification was developed (see Appendix A). This specification would be used to purchase a test valve from vendors that could supply a valve meeting the requirements of Project W-521. It should be noted that since this specification is for procurement of test valves only, no Certificates of Conformance and other submittals would be requested. The items that are for the final procurement specification only are noted as such in the specification provided in Appendix A. The following vendors expressed an interest in providing a three-way valve for testing:

- Worcester Controls
- PBM, Inc.
- SVF Flow Controls, Inc.
- KITZ Corporation

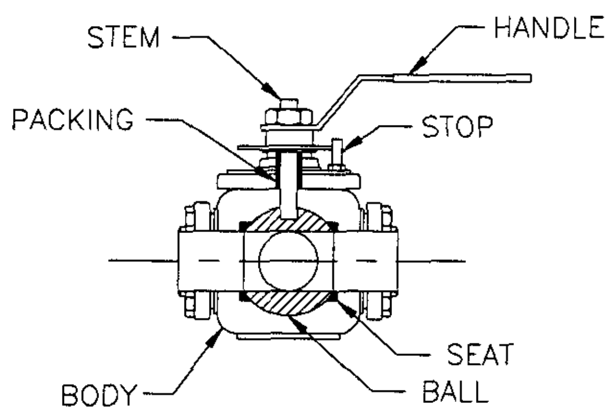

Figure 4-1. Typical Three-Way Valve.

Parallel to developing the procurement specification, a test plan was prepared (see Appendix B). Basically, the tests identified in the test plan coincide with the concerns that were voiced with the Project W-211 and W-314 valves - leaking stems, leaking seats, and high torques. Stem seal leakage would be checked by applying a force to the top of the valve stem. When this type of loading was placed on the valves used by Project W-314, a spray leak occurred through the stem packing. An industry standard seat closure test (API Standard 598 and ASME B16.34) would demonstrate adequate seat tightness of the valve while a simple torque test on the valve stem would demonstrate acceptable torque values. All testing was planned to be performed on-site at the 305 Engineering Testing Laboratory.

After contacting various vendors, it was determined that purchasing of new valves for testing would require several months. Since the scope of the ACD did not allow that much time, an alternative plan was developed. The procurement specification and test plan would be completed, however, full-scale procurement of the test valves would not be initiated until the start of definitive design. This would still allow testing to be complete prior to the need of the valves for construction. The completed specification and test plan are in Appendix A and B, respectively.

One 3-in. three-way valve was retrieved from a canceled project. This was a 3-in. three-way Worcester Controls valve that was to be used in one of the process pits, however, the seat material would not meet the radiation requirements identified for the W-521 Project. Worcester Controls offered to replace the seats at no cost and return the valve for testing, however, results of these modifications were not available before the end of the ACD. However, it is believed that the modifications by Worcester Controls would substantially reduce the operating torque. Their approach is to treat the PEEK seats like a metal seat and machine an o-ring groove on the backside of the seat. The softer o-ring material would then not require as much torque on the valve body bolts which would translate to a lower valve operating torque. Verification of the final torque and other testing of this valve will be done with all of the other supplied valves during definitive design.

4.2 Subtask 2 - Two-Way Valve Investigation

The majority of the concerns and problems associated with the process pit valves have been with the three-way valves. Therefore, the purpose of this subtask was to determine if each of the process pits could be arranged with all two-way valves. Typically, a three-way valve would be replaced with two two-way valves, however, since flow can be in either direction for most of the process pit piping, three two-way valves are required as shown in Figure 4-2.

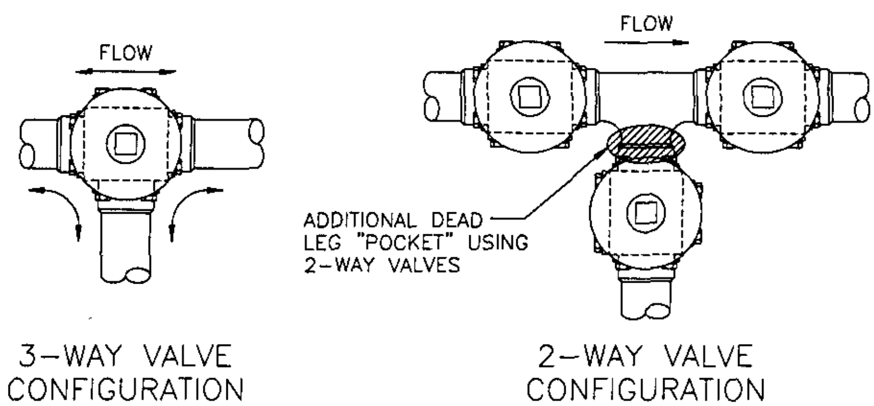

Figure 4-2. "Pockets" with Two-Way Valves.

One initial drawback seen with the two-way valve configuration is the small dead leg created were waste could be accumulated. This is not a concern on the diluent jumpers, however, with the exception of the 241-AP Valve Pit, there is usually only one three-way valve associated with the diluent routing in a pit. Therefore, this analysis will be based only on the waste transfer jumpers and any conclusions will be applied to the diluent jumpers for consistency in design.

For the 3-in. waste transfer jumpers, the dead legs can be minimized so that the "pockets" are no more than 4-inches in length by welding the valves to the end of the tee (see Figure 4-2). However, this type of arrangement will cause some of the valves to have a center-to-center distance of less than 12-inches. This close proximity could create some interference problems with the valve operators above the cover blocks. It should be noted that these dead legs are not permanent where buildup would continue to increase. That is, the different routings possible within the jumper will change which leg of a tee will be the dead leg. However, to completely remove the possibility of buildup in these pockets, the jumpers would need to be flushed through each of the dead legs in the transfer route.

The primary advantage in using two-way valves over three-way valves would be in the area of operations. The two-way valves are either opened or closed which makes valve positioning easier. With a three-way valve there is no valve stop for the middle position, therefore, the operator is required to line up the middle valve position with the aid of paint markings and limit switches. These markings and switches must insure that the valve is within ±5° of the true middle position or the valve seats will not stop leak by to the other legs. Also, the torque requirement of a two-way valve is lower making it easier to operate. Finally, the number of qualified suppliers is higher for two-way valves. Only Worcester Controls and PBM, Inc. have substantial experience with three-way valves in nuclear environments.

The first tasked involved in the two-way valve investigation was to prepare new jumper arrangement drawings for the process pits. Each of the pits was reconfigured without much difficulty. The new arrangements are shown in Appendix C. The main issue with these new arrangements is the increased stiffness of the jumpers. The valves are a rigid component and with the increase in the number of valves on the jumper, the jumper becomes less flexible. In addition, these new arrangements require some of the jumpers to have fitting-to-fitting connections in order to make them fit which also reduces the flexibility of the jumper. This stiffness of the jumpers is a concern since less flexibility leads to higher thermal stresses and larger loads being transmitted to the pit nozzles.

For Subtask 2, the number of valves increased from the 111 total valves in the Conceptual Design Report (CDR) to 165 total valves using all two-way valves. The change in the number of valves for each of the pits is summarized in Table 4-1.

Table 4-1. Change in the Number of Valves

Pit Number	Conceptual				Advanced Conceptual	
	2" 2-way	2" 3-way	3" 2-way	3" 3-way	2" 2-way	3" 2-way
AW-01A, -03A, -04A; SY-01A, -02A, -03A	1	1	3	1	2	6
AW-02A	0	0	5	4	0	16
AY-01A	2	1	3	2	5	5
AY-02A	2	1	5	4	5	9
AP*	13	6	13	8	31	35
AP-A*	0	0	8	5	0	19
SY-A*	4	2	4	3	8	9
SY-B*	3	1	4	2	6	9
Subtotal	**25**	**12**	**45**	**29**	**57**	**108**
Total	**111**				**165**	

* Valve Pits

Finally, an estimate was prepared to determine the cost differences between the three-way and two-way valve arrangements. Three different estimates were prepared based on the following three options:

- Option 1, Two-Way Valve Configurations w/ Valve Operators
- Option 2, Two-Way Valve Configurations w/ T-Handles
- Option 3, CDR Configuration w/ T-Handles

To switch to a manual "T-handle" operator instead of the CDR gear/motor-operator the torque to operate the valve must be approximately 80 ft-lbs (See Figure 4-3). This is assuming that a long enough T-handle could be used to support the human factor guidelines for the amount of force that can be applied by an operator. For the type of valve seat required in a waste transfer jumper, this low of torque will only be achievable on the two-way valves. However, some additional testing will need to be done to determine if this is even achievable.

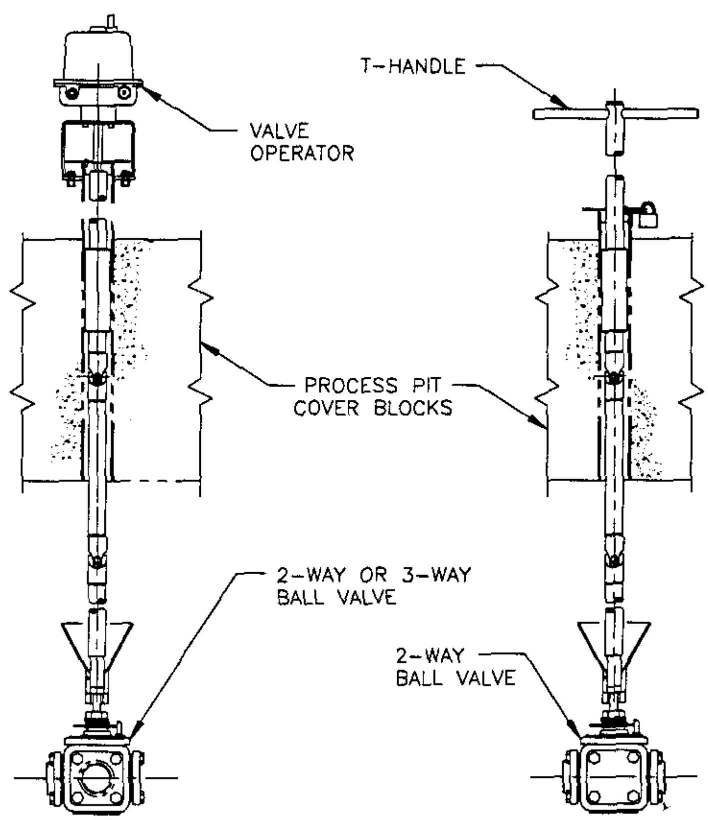

Figure 4-3. Typical Valve Operator and T-Handle.

Option 1 looked at the cost difference due to the increase in the number of valves with no other changes. Although the cost of two-way valves are less than three-way valves, there was an increase of 54 more valves and associated equipment (i.e., valve funnel assemblies, position switches, and gear/motor-operators).

Options 2 and 3 were based on the elimination of the gear-operators on the manual valves in the valve pits. Option 2 used the new all two-way valve arrangements and changed the gear/motor-operators to T-handles. As seen from Table 4-1, this affected 45 2-in. valves and 72 3-in. valves in the valve pits. Option 3 was based on the CDR configuration that utilized both two- and three-way valves and changed the gear/motor-operators to T-handles on the two-way valves only. Again using Table 4-1, this affected 20 2-in. valves and 29 3-in. valves in the valve pits.

In addition to the 3-in. three-way valve retrieved from a canceled project (See Section 4.1), two surplus 3-in. two-way Worcester Controls valves were obtained. These valves had PEEK seats that would support the radiation requirements stated in the procurement specification. However, Worcester Controls would modify one of the valves to see if they could reduce the operating torque to 80 ft-lbs or less. As with the three-way valve, the modification to this valve could not be completed prior to the end of ACD, therefore, it will be tested with all of the other three-way valves in definitive design. The purpose of this test will be only to demonstrate that a torque of 80 ft-lbs is achievable on a 3-in. two-way valve with PEEK seats. If the testing is successful, it will then be assumed that other vendors could meet this torque requirement on the two-way valves and it will be placed in the final procurement specification. The second two-way valve obtained will be used to provide an initial benchmark on how much reduction in the torque can be obtained.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Subtask 1 - Evaluation and Test

As stated in the earlier discussions, the ACD schedule does not allow enough time for a detailed evaluation of the two-way and three-way valves. However, with the functions and requirements determined and provided in the procurement specification, testing can began at the start of definitive design. In discussion with various vendors, it is highly likely that the leaking stem and seat issues would be eliminated, and that torque values will be reduced to manageable values. It appears that the leaking stem was due to the stem design on the valves procured by Project W-314. To keep others from using a similar design, the procurement specification provided includes a statement that the valve stem could see a lateral load. The leaking seats and high torques are again somewhat unique to the valve design used by Project W-314, however, it should be noted that the vendor for Project W-314 has also made modifications to their design to eliminate these issues. For Project W-521, there will be no cost change to the CDR baseline due to the elimination of these issues.

5.2 Subtask 2 - Two-Way Valve Investigation

The resulting cost estimate analysis showed that for Option 1, there would be an increase in cost to the CDR baseline of approximately $2,700,000 to use all two-way valves. Assuming the valve pit operators could be eliminated for the two-way valves, there would be a decrease in cost to the CDR baseline of approximately $990,000 for Option 2 versus a decrease in cost to the CDR baseline of approximately $1,550,000 with the CDR pit configuration Option 3.

As shown in the estimate analysis, the change to two-way valves would be financially beneficial only if the manual "T-handles" could be used. If the T-handles cannot be used, it would only be beneficial to use all two-way valves if the increase in initial cost would be worth the reduced ease/risk in the operator's ability to ensure proper valve alignment. In addition, the increase in the risk of plugging the transfer routing due to the additional dead leg pockets must be taken into account.

It is recommended that Project W-521 stay with the three-way valve configurations developed in the CDR for the following reasons:

1. One three-way valve will eliminate the need for three two-way valves. To minimize the "pockets" using two-way valves, each three-way valve would need to be replaced with three two-way valves. This would create complex pit arrangements that require many jumpers that have fitting-to-fitting connections. This type of jumper is very rigid which tends to lead to high thermal stresses and large loads being transferred to the pit nozzles.

2. The issues that prompted this valve type analysis can be eliminated. Three-way valves are commonly used in other commercial and nuclear industries without leaking seats and stems. In addition, preliminary results with modifying the seats indicate that reasonable torques can be achieved. Finally, with local and remote position indicators on all valves, operators should not have a problem with positioning the three-way valves.

At this time, there will be no change made to the CDR estimate. The cost savings shown by Option 3 are contingent upon testing of the valves and it is not known at this time if a low enough torque will be achievable to eliminate the CDR gear/motor-operators on the two-way valves.

5.3 Cost

Although no change will be made to the CDR estimate at this time, the cost reduction associated with Option 3 is shown in Table 5-1, and is included in the overall trended estimate.

Table 5-1. Cost

VALVE TYPE ANALYSIS (OPTION #3) - REDUCTION FROM CDR												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$402,136	-$75,269	-$161,701	-$31,955	-$76,693	-$52,726	-$10,865	-$76,693	-$31,955	-$144,140	-$215,742	-$265,646	-$1,545,521

6.0 REFERENCES

API Standard 598, 7th Edition, 1996, Valve Inspection and Testing, American Petroleum Institute, Washington, D.C.

ASME B16.34, 1996, *Valves-Flanged, Threaded, and Welding End*, American Society of Mechanical Engineers, New York, NY.

HNF-2004, Rev. 1, *Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering Corporation for Fluor Hanford, Richland, Washington.

HNF-4160, Rev. 0, *Double-Shell Tank Transfer Valving Subsystem Specification*, Fluor Federal Services for CH2M HILL Hanford Group, Inc., Richland, Washington.

W-314-P1, Rev. 0, *Procurement Specification for Ball Valves AN Valve Pit Upgrades*, Fluor Federal Services, Richland, Washington.

Appendix A
Procurement Specification for Test Valves

PROCUREMENT SPECIFICATION FOR TEST VALVES FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46
Report No. 990920203-009
ADCR Subtask 1
Revision 0

September 2000

prepared by

HND Team

PRELIMINARY

PROCUREMENT SPECIFICATION FOR TEST VALVES FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-009
ADCR Subtask 1
Revision 0

September 2000

Prepared by: Tom Salzano, P.E.

Approved by: ______________________
Larry Shipley, P.E.

Date: ______________________

PRELIMINARY

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Tables

Acronyms

API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
MSDS	Material Safety Data Sheets

1.0 SCOPE

The specification provides minimum requirements for three-way ball valve assemblies to be used as diversion valves in radioactive liquid waste process piping. This specification is for the procurement of one valve to be tested by the Buyer to select a valve supplier(s) for all of the process valves to be used for the Waste Feed Delivery Systems. Testing by the Buyer will verify conformance to this specification. All suppliers that meet these requirements will be asked to bid on the procurement of the remaining project valves pending the start of the project, however, acceptance by the Buyer will not guarantee further procurement.

1.1 Work Included

Fabrication, inspection, testing, documentation, packaging, and shipment.

1.2 Work Not Included

Site services.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent designated, except as modified by the requirements specified herein. The latest edition with addenda shall be used unless noted otherwise.

2.1 Code and Standards

2.1.1 American Society of Mechanical Engineers (ASME)

- B16.10 Face-to-Face and End-to-End Dimensions of Valves
- B16.34 Valves - Flanged, Threaded and Welding End
- B31.3 Process Piping

2.1.2 American Society of Testing and Materials (ASTM)

- A 312 Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes

2.1.3 American Petroleum Institute (API)

- Standard 598 Valve Inspection and Testing

3.0 REQUIREMENTS

3.1 Valve Description

The three-way ball valve shall be side entry, 180° operation, with a T-port ball option. The valve shall be designed for diverting flow and for manual operation through a drive mechanism located approximately 6 feet above the valve. A typical valve installation is shown in Figure 3-1.

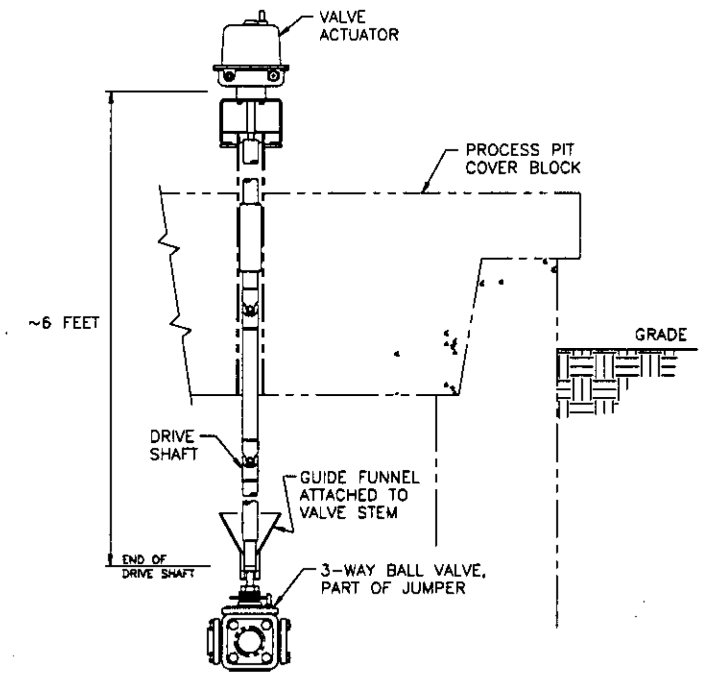

Figure 3-1. Typical Valve Installation.

3.2 Fluid Composition and Properties

The valve shall be capable of handling fluids with the chemical composition shown in Table 3-1 and the following properties:

	Range
Liquid Density	76 to 91 lb/ft^3 (1.21 to 1.46 kg/L)
Liquid Viscosity	1.0 to 10 cP
Solids Density	156 to 187 lb/ft^3 (2.50 to 3.00 kg/L)
Solids Mean Diameter	40 to 400 µm
Solids Volume Percent	10 to 30 %
Temperature (Transfer)	50 to 200 °F
Ph	7 to 13+
Radiation	6 x 10^7 Rad (Total Lifetime Accumulated Dose)

Table 3-1. Fluid Chemical Composition

Constituent	Concentration (M)
NaOH	0 to 2.5 (generally 1.0)
$NaAlO_2$	0 to 2.0
$NaNO_2$	0 to 3.0
$NaNO_3$	0 to 4.0
Na_2CO_3	0 to 0.5
Na_3PO_4	0 to 1.0
Na_2SO_4	0 to 1.0
NaF	0 to 0.2
Total Na^+	<5.5

3.3 Environmental Conditions

The valve assembly shall be capable of operating in the following environmental conditions:

- Ambient Air Temperature Range: 120°F to -32°F with a maximum 24 hour differential of 52°F
- Relative Humidity: 0 to 100 percent

3.4 Material Requirements

3.4.1 All materials shall meet the requirements specified in ASME B16.34.

3.4.2 All materials shall be selected by the Seller based on acceptable performance when subjected to the chemical and radiation exposures provided in Section 3.2. Material selection shall be identified within the design review data for Buyer review. Material identification shall include the applicable ASTM specification number and any proposed supplementary feature that is listed as optional in the ASTM specifications.

3.4.3 All elastomers (e.g., seats, seals, and packing) used shall be approved by the Buyer. Chemical and physical properties and the elastomers shall be suitable for the chemical and radiation environment in which they are used. A letter of certification shall be provided listing the chemical, radiological, and physical properties and affirming that seat, seal, and packing materials are resistant to the environment in which the assembly will be used (Para 3.2).

3.4.4 Valve body bolt materials shall match the valve body (i.e., Stainless steel valves shall have stainless steel bolts.).

3.5 Design Requirements

3.5.1 The valve shall be furnished fully assembled.

3.5.2 The valve shall be side entry.

3.5.3 The valve shall support a hydrostatic pressure test of 675 psig.

3.5.4 The valve shall be a rigid assembly such that any piping loads on the valve will be carried by the valve body and not the seals. Valves with adjustable seals or valves with pipe ends that do not form a metal-to-metal seal with the valve body are not acceptable.

3.5.5 The valve shall be designed to operate for at least 1000 cycles over a 12-year design life.

3.5.6 The valve body shall meet the requirements of ASME B31.3 and ASME B16.34 for a minimum working pressure of 450 psig at 200 °F.

3.5.7 The valve shall be furnished with butt weld ends suitable for welding to Schedule 40S pipe (ASTM A 312 TP 304L) in accordance with ASME B31.3 and with end-to-end dimensions in accordance with ASME B16.10.

3.5.8 The valve seats shall seal against leakage in either direction against 1 psig to 450 psig entering pressure and 0 psig exit pressure. The valve shall have no visible leakage per the requirements of API Standard 598. The test shall be repeated with a test duration time of 10 minutes. The leakage rate shall be less than 12 drops per minute as defined in API Standard 598.

3.5.9 The valve ball shall be full port and shall support the flow pattern indicated in Figure 3-2.

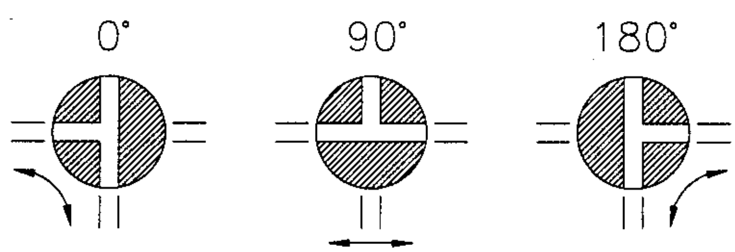

Figure 3-2. Required Flow Pattern.

3.5.10 The valve stem shall be able to support a lateral loading of 10 lbs being applied to the top of the stem.

3.6 Fabrication Requirements

3.6.1 The valve shall be fabricated and assembled in accordance with ASME B16.34.

3.6.2 The valves assembly shall be subject to a closure test performed in accordance with paragraph 7.2 of ASME B16.34.

3.6.3 The valves shall be provided with stops. The stops shall be designed to resist failure due to shear (i.e., rolled pins are not acceptable).

3.6.4 The required breakaway torque shall not exceed 3500 lb-in after a period of stagnant position of up to six months. A written statement shall be provided affirming that this value will not be exceeded.

3.6.5 Do not paint corrosion-resistant steel surfaces.

3.6.6 Galvanized surface finishes are unacceptable.

3.7 Markings

The valve shall be marked per the requirements of ASME B16.34. In addition, the valve shall be identified by either a wired or permanently attached stainless steel tag stamped with the following data:

- Valve design pressure.
- Valve design temperature.
- Trim material.
- Seat and seal material.
- Year manufactured.

3.8 Cleaning Requirements

The valve internal and external surfaces shall be cleaned in accordance with the manufacturer's standard.

3.9 Inspection/Examination

A shell and valve closure test shall be performed on the valve in accordance with ASME B16.34, with no visible leakage per the requirements of API Standard 598. The closure test shall be repeated for a test duration time of 10 minutes with less than 12 drops per minute of leakage as defined in API Standard 598. Testing shall be documented.

4.0 QUALITY ASSURANCE REQUIREMENTS

Manufacturer's standard. No suspect fasteners as identified in Figure 4-1 shall be used.

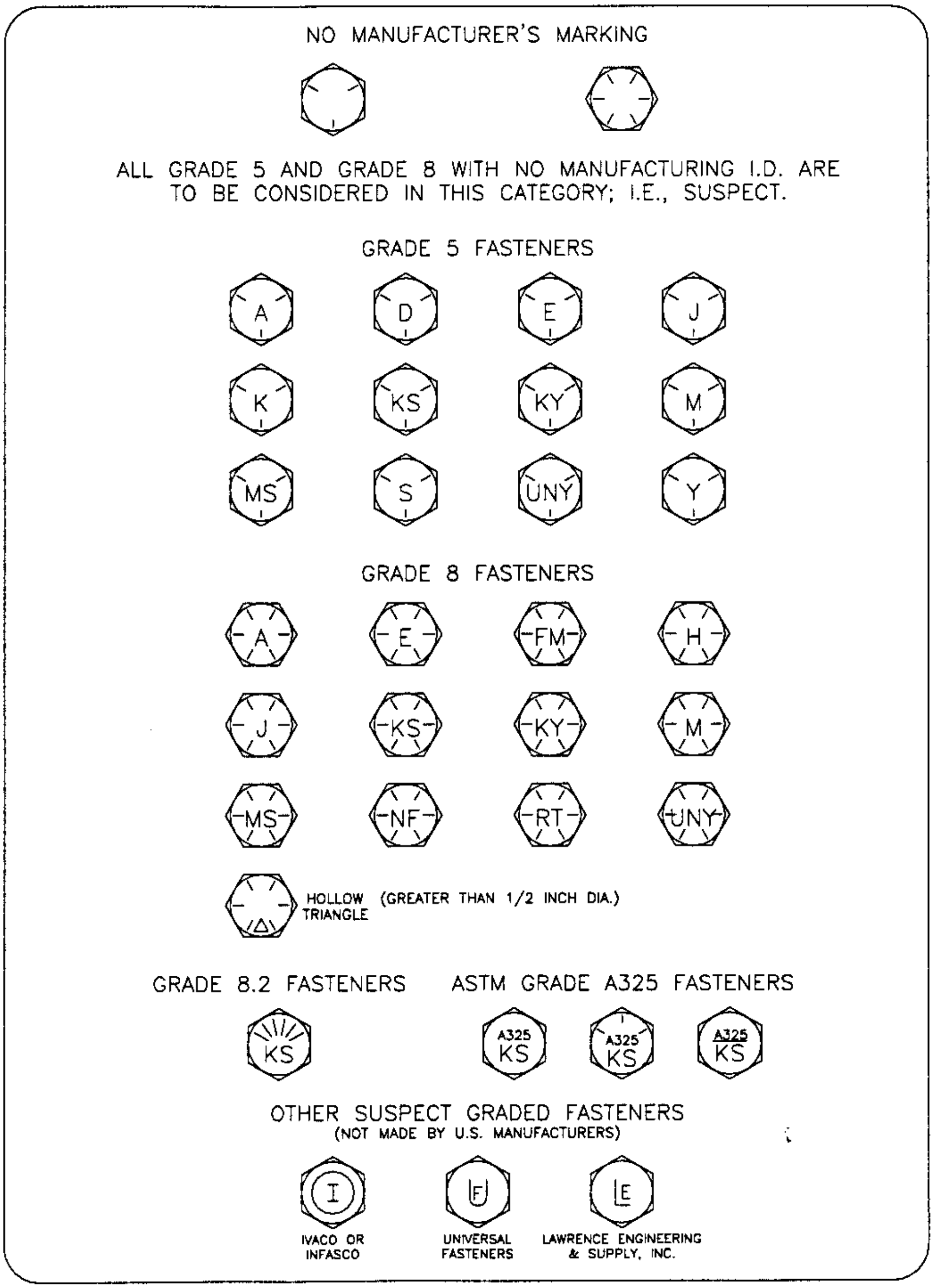

Figure 4-1. Suspect Fastener Headmark List.

5.0 SUBMITTALS

See Table 5-1 for number of copies, purpose, and when required.

5.1 General

- Identify each submittal by this Specification number, item number, PO number, and Seller's identification number.

- Data shall be sufficiently clear to allow legible copies to be made on standard reproduction equipment after microfilming.

- Approval by the Buyer does not relieve the Seller of responsibility for accuracy or adequacy of design under this Specification.

- Submittals "not requiring approval" will be reviewed to verify completeness and adequacy for their intended purposes. Unacceptable items will be handled as specified below:

- A submittal requiring approval that is not approved, is identified as: 1). "Not Approved Revise and Resubmit." The submittal is considered technically deficient, or incomplete, and therefore unacceptable. Resubmittal is required, hence fabrication, procurement, or performance of procedures shall not proceed; 2) "Approved with Exception." Fabrication, procurement, and performance of procedures may proceed, and resubmittal is required to verify incorporation of the exception.

- Submittals "not requiring approval" that are determined to be incomplete or inadequate will be returned marked "Resubmit." An explanation of the deficiencies will be included for corrective action by the Seller.

- Seller may take exception to any Specification requirement. Identify exception and obtain Buyer's approval before implementation.

5.2 List

- (Item 1) Valve assembly drawings with dimensions and weight.

- (Item 2) Valve material lists.

- (Item 3) Hydrostatic/leak test documentation (Paragraphs 3.5.8 and 3.9).

- (Item 4) As-builts of drawings.

- (Item 5) Material Safety Data Sheets (MSDS) for hazardous materials. If hazardous materials are not used, provide written statement to that effect. (This item only required for final procurement.)

- (Item 6) Certificate of Conformance for other materials (Paragraph 3.4.3). (This item only required for final procurement.)

- (Item 7) Breakaway Torque Statement (Paragraph 3.6.4). (This item only required for final procurement.)

- (Item 8) Installation instructions.

- (Item 9) Operation and maintenance manuals.

6.0 PREPARATION FOR DELIVERY

- Preservation: Item shall be protected from dirt, soil, and moisture.

- Packaging: Item shall be boxed or crated in a manner to prevent damage during shipping.

- Marking: Packages shall be suitably marked on the outside to facilitate identification of the purchase order, the procurement specification, the package contents, and any special handling instructions.

- The Seller shall recommend the preferred method of shipping and provide protection of the equipment during transit and storage.

Table 5-1. Summary of Submittals

Item	Title	Copies	Purpose	When Required
1	Valve Drawings	3	Approval	Before purchase
2	Valve Material Lists	3	Approval	Before purchase
3	Hydrostatic/Leak Test Data	3	Vendor Information	With shipment
4	As-Built Drawings	3	Vendor Information	With shipment
5	Material Safety Data Sheets	3*	Vendor Information	With shipment
6	Certificate of Conformance	3*	Vendor Information	With shipment
7	Breakaway Torque Statement	3*	Vendor Information	With shipment
8	Installation Instructions	3	Vendor Information	With shipment
9	Operations and Maintenance Manuals	3	Vendor Information	With shipment

NOTE: days shown are calendar days.
*Only required for final procurement.

END OF TEXT

Source of Supply:

1. Worcester Controls
   Woodinville, WA
   (425)481-9078

   Attn: Steve Williams

2. SVF Flow Controls, Inc.
   Timberline Process & Controls, Inc.
   North Bend, WA
   (425)888-3335

   Attn: Randy Tweten

3. KITZ Corporation
   Timberline Process & Controls, Inc.
   North Bend, WA
   (425)888-3335

   Attn: Randy Tweten

4. PBM, Inc.
   Tourangeau Nor Wes Corporation
   Tualtin, OR
   (503)691-6100

   Attn: Wayne Eads

For information only
Not part of document

Appendix B
Valve Test Plan

VALVE TEST PLAN FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46
Report No. 990920203-008
ACDR Subtask 1
Revision 0

September 2000

prepared by

HND Team

PRELIMINARY

VALVE TEST PLAN FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-008
ACDR Subtask 1
Revision 0

September 2000

Prepared by: Steven Weaver
Tom Salzano, P.E.

Approved by: ______________________
Larry Shipley, P.E.

Date: ______________________

PRELIMINARY

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Acronyms

API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
NIST	National Institute of Standards and Technology

1.0 INTRODUCTION

This test plan establishes test methods, performance requirements, and applicable codes and standards for onsite valve testing for the valve type analysis activity included within the scope of the Project W-521 Advanced Conceptual Design.

Project W-521 has selected common two-way and three-way valves from commercial sources for use in tank farm waste transfer systems. Issues have been raised, based on tank farm operating experiences, concerning valve operability and reliability in a tank farm environment. This test plan will provide input to a valve test program evaluating available valves with the intent of making recommendations as to the most appropriate valves to be used by Project W-521 and other projects.

2.0 SCOPE

This test plan is applicable to valves obtained from the *Project W-521, Waste Feed Delivery Project Procurement Specification for Test Valves*. The scope of this test plan is limited to testing of selected key operating parameters that directly affect operability and reliability in a tank farm environment. Specifically, seat leakage, stem leakage, and operating torque for tank farm valves have been an ongoing concern.

This test plan will identify all key technical parameters required for each test; acceptance criteria based on valve and system design requirements; facilities, equipment, and materials; and the responsibilities of organizations involved in the testing. Although testing is limited to three-way valves, it is expected that results will be applicable also to two-way valves.

3.0 GENERAL INFORMATION

3.1 Test Items

The valves to be tested according to this test plan are 3-inch, three-way ball valves obtained from commercial sources in response to the *Project W-521, Waste Feed Delivery Project Procurement Specification for Test Valves*. The valves are intended for diverting flow and shut-off or isolation service in a tank farm environment. The valves will be furnished fully assembled. Specific material and performance requirements are identified in the procurement specification.

3.2 Facilities and Equipment

All testing will be performed at the testing organization's facilities. The following test equipment will be necessary to perform the tests identified in this test plan:

- A test stand for holding 3-inch ball valves during testing.

- Closure devices (e.g., bolted flanges, threaded plugs) for the valve ports. Alternately, the closure devices will provide a pressure boundary during pressure testing, a vent path to atmosphere during seat leakage testing, a means to relieve air from the valve internals, and a means to connect the test pump assembly to the valve.

- A test pump assembly for filling, venting, and pressurizing the valve. The assembly will include a volumetric device, calibrated in milliliters/hour, for measuring seat leakage. A means to positively isolate (e.g., quick disconnect, two closed valves with an open vent path between the valves) the water source during seat leakage testing will be provided.

- A test adaptor and means to apply a measured lateral force to the valve stem during the Stem Leakage Test.

- A calibrated torque wrench for measuring valve operating torques up to 4000 in-lbs.

3.3 Quality Assurance

Valve testing specified in this test plan shall be performed according to written procedures that comply with this test plan, referenced codes and standards, and applicable site procedures for technical procedures.

Valve disassembly and reassembly shall be performed according to written procedures that comply with valve manufacturer recommendations and appropriate site procedures. The extent of valve disassembly will be limited to that performed during normal installation of the valve in a valve/jumper manifold.

All test equipment shall have been calibrated prior to testing with devices of accuracy traceable to the National Institute of Standards and Technology (NIST).

3.4 Organization and Functional Responsibilities

3.4.1 Design Agent

- The Design Agent will coordinate with the testing organization to assist development of test procedures.

- The Design Agent will review and approve the test procedures.

- The Design Agent will witness selected tests as determined necessary by the Design Agent.

- The Design Agent will review, analyze, and approve test results to verify acceptability of the valve being tested.

- The Design Agent will provide test deficiency resolution and oversee troubleshooting of technical problems.

- The Design Agent has sole responsibility for controlling and modifying this test plan.

3.4.2 Testing Organization

- The testing organization is responsible to ensure that testing is performed according to this test plan, referenced codes and standards, and applicable site procedures.

- The testing organization will prepare written test procedures according to their applicable site procedures and this test plan.

- The testing organization is responsible for providing all test equipment and for the adequacy and accuracy of test equipment.

- The testing organization will implement appropriate test methods and controls, assure that the specified tests and inspections are completed satisfactorily, and document test results and any test deficiencies according to this test plan and applicable site procedures.

- The testing organization will provide adequate notification and access to the test facility to allow the Design Agent to witness testing.

3.5 Schedule

The testing organization shall provide the Design Agent five (5) working day's notice prior to the specified valve testing.

4.0 DESCRIPTION OF TESTS

4.1 Stem Leakage Test

4.1.1 Objective

The Stem Leakage Test will demonstrate stem seal tightness at the specified test pressure. Stem seal tightness will be verified with and without a lateral force applied to the valve stem. The lateral force is meant to simulate actual conditions that could be applied to a valve being operated with an extension handle through a pit cover block.

4.1.2 Criteria and Constraints

1. The Stem Leakage Test will be performed with and without a lateral force of 10 lbs applied to the top of the valve stem. This will simulate a valve extension handle being off true and placing a force on the stem.

2. The test fluid shall be water. If a corrosion inhibitor is used, it shall comply with Section 7.1 of American Society of Mechanical Engineers (ASME) B16.34.

3. The test pressure shall be not less than 150 percent of the 450 psig design pressure (i.e., 675 psig).

4. The duration of each stem leakage test shall be not less than 60 seconds. The test duration is the inspection period after the valve is fully prepared and full test pressure has been applied to the valve.

5. The Stem leakage Test will be performed with the valve in the 0° and 180° positions.

4.1.3 Data

The following data and/or test parameters shall be included or recorded in the test procedure: valve type, serial number, manufacturer, seat material, body and ball material; test fluid type and temperature, test pressure, test duration, the lateral force applied to the top of the stem, and whether leakage was observed. The test director shall identify whether the test was satisfactory and any actions (e.g., valve cycling) performed to obtain satisfactory results.

4.1.4 Expected Results

The valves being tested are new and no leakage should be visible from the stem seals. Therefore, the acceptance criteria for a satisfactory test shall be no visible leakage from the stem seals after 60 seconds with the valve pressurized to 150 percent of the design pressure.

4.1.5 Procedure Outline

1. Install the valve in a test stand.

2. Cycle the valve a minimum of 3 times.

3. Fill the valve with test fluid. Provide a vent path to relieve air from the valve while filling the valve.

4. Position the valve in the 0° or 180° position.

5. Pressurize the valve and check the stem seal for leakage.

6. Place an extension on the valve stem so that the lateral load can be applied at a distance of at least 6-inches from the top of the valve.

7. Apply a force of approximately 10 lbs at a distance of 6-inches from the top of the valve.

8. Check the stem seal for leakage.

9. If stem leakage is unsatisfactory, the valve may be cycled and the test repeated.

10. Repeat the Stem Leakage Test with the valve positioned in the 180° position.

4.2 Seal Closure Test

4.2.1 Objective

The Seat Closure Test will demonstrate adequate valve seat tightness at the specified test pressure. Seat tightness will be verified with the 3-way ball valve in all possible positions and with test pressure applied successively to all sides of the valve (ball) as identified in Figure 4-1.

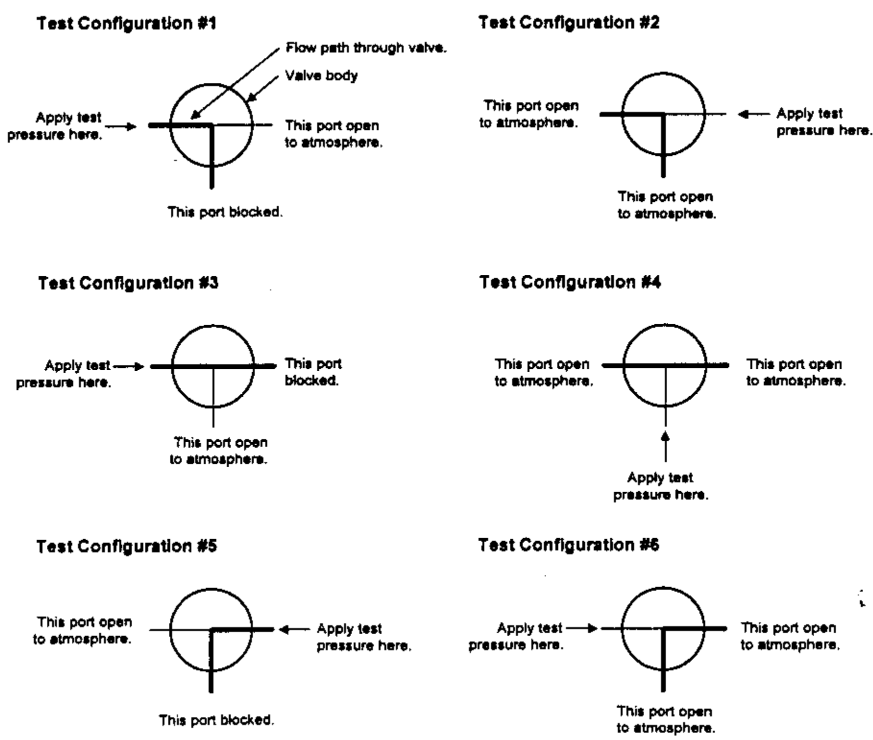


Figure 4-1. Seat Closure Test Configurations.

4.2.2 Criteria and Constraints

1. The Seat Closure Tests are performed according to test methods identified in ASME B16.34, American Petroleum Institute (API) Standard 598, and this test plan.

2. The test fluid shall be water. If a corrosion inhibitor is used, it shall comply with Section 7.1 of ASME B16.34.

3. The test pressure shall be not less than 150 percent of the 450 psig design pressure (i.e., 675 psig).

4. The duration of each seat leakage test shall be not less than 10 minutes. The test duration is the inspection period after the valve is fully prepared and full test pressure has been applied to the valve.

5. Test pressure shall be applied successively on each side of the valve with the other side(s) open to the atmosphere. Leakage is checked with a volumetric device on the pump suction or at the opposite (open) valve port(s). The test shall be performed with the 3-way valve in all possible positions. These configurations are illustrated in Figure 4-1.

6. A volumetric device, calibrated in ml/hour, is the preferred method of leakage detection. Pressure decay devices will not be used for leakage detection.

7. The allowable leak rate shall be achieved with the valve position approximately 5 degrees from each position stop. This is to simulate field conditions were the position indication can be off by ±5° of the actual valve stop.

4.2.3 Data

The following data and/or test parameters shall be included or recorded in the test procedure: valve type, serial number, manufacturer, seat material, body and ball material; test fluid type and temperature, test pressure, test duration, and measured leak rate. The test configuration as illustrated in Figure 4-1 will also be identified. The test director shall identify whether the test was satisfactory and any actions (e.g., valve cycling, valve seat flushing) performed to obtain satisfactory results.

4.2.4 Expected Results

The maximum allowable leakage rate per API Standard 598 is 0 ml/hr. That is, there shall be no visible leakage for the minimum specified test duration.

4.2.5 Procedure Outline

1. Install the valve in a test stand.
2. Cycle the valve a minimum of 1000 times.
3. Establish a test configuration illustrated in Figure 4-1.
4. Position the valve approximately 5 degrees off (from) the valve position stop. (Note: This is not applicable when the valve is being tested in the middle position.)
5. Fill the valve with test fluid. Provide a vent path to relieve air from the valve while filling the valve.
6. Pressurize the valve and check for leakage. Record leakage.
7. Cycle the valve 100 times recording the leakage rate after every 10 cycles.
8. Repeat the Seat Closure Test for each configuration illustrated in Figure 4-1.
9. Ensure the pre-disassembly Operating Torque Tests have been completed.
10. Disassemble and reassemble the valve per approved procedures. Each valve will be disassembled once; it is not necessary to disassemble the valve before each test (i.e., Seat Closure Test and Operating Torque Test).
11. Repeat the Seat Closure Test.

4.3 Operating Torque Test

4.3.1 Objective

The Operating Torque Test will demonstrate that the torque required to operate the valve is acceptable. The valve will be operated multiple times and the measured operating torque compared to manufacturer data and criteria from the valve procurement specification.

4.3.2 Criteria and Constraints

1. The valve will be filled with water for the Operating Torque Test. If a corrosion inhibitor is used, it shall comply with Section 7.1 of ASME B16.34.

4.3.3 Data

The following data and/or test parameters shall be included or recorded in the test procedure: valve type, serial number, manufacturer, seat material, body and ball material; test fluid type and temperature, vendor torque specifications if any, and measured breakaway and operating torque.

4.3.4 Expected Results

The valves being tested are new and the expected operating torque should be within vendor and procurement specification criteria.

4.3.5 Procedure Outline

1. Install the valve in a test stand.
2. Cycle the valve a minimum of 3 times.
3. Cycle the valve an additional 10 times. Measure and record the torque required to operate the valve in each direction.
4. Fill the valve with test fluid.
5. Cycle the valve an additional 10 times. Measure and record the torque required to operate the valve in each direction.
6. Let the valve stand for a period of time to be determined by the Design Agent (i.e., one to two weeks).
7. Repeat the Operating Torque Test.
8. Ensure the pre-disassembly Stem Leakage Test and Seat Closure Tests have been completed
9. Disassemble and reassemble the valve per approved procedures. Each valve will be disassembled once; it is not necessary to disassemble the valve before each test (i.e., Seat Closure Test and Operating Torque Test).
10. Repeat the Operating Torque Test.

5.0 REPORTS

Test results will be documented in letter report and/or test report prepared by the Design Agent.

6.0 REFERENCES

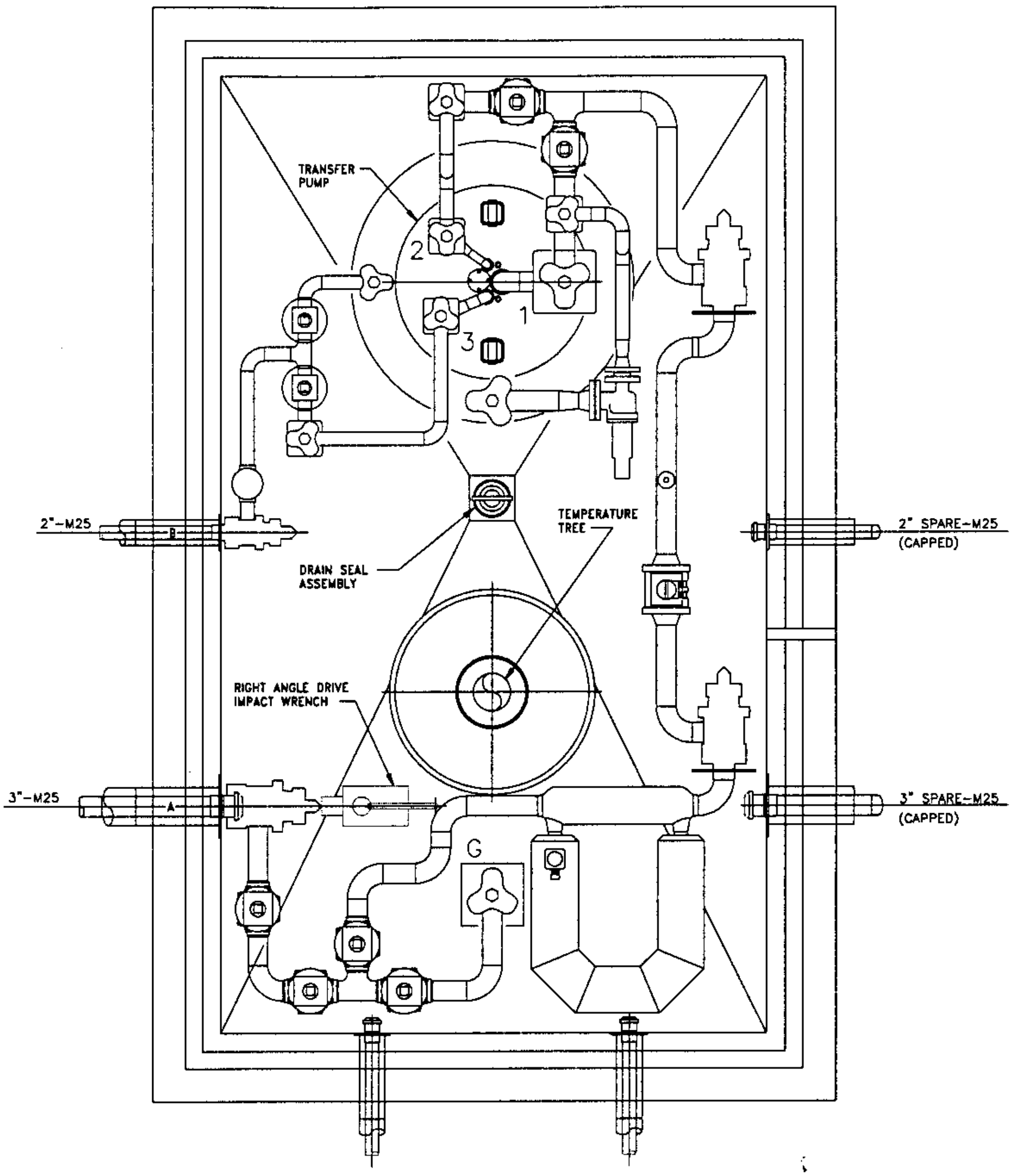
HNF-4160, Rev. 0, 2000, *Double-Shell Tank Transfer Valving Subsystem Specification*, CH2M Hill Hanford Group, Inc. for Flour Federal Services, Richland, Washington.

Report No. 990920203-009, *Project W-521, Waste Feed Delivery Project Procurement Specification for Test Valves*, HND Team.

ASME B16.34-1996, Valves-Flanged, Threaded, and Welding End.

API Standard 598, Valve Inspection and Testing, Sixth Edition, September 1990.

Appendix C
Process Pit Arrangement Drawings



PLAN
CENTRAL PUMP PIT
241-AW-01A/03A/04A
241-SY-01A/02A/03A

SCALE: NONE
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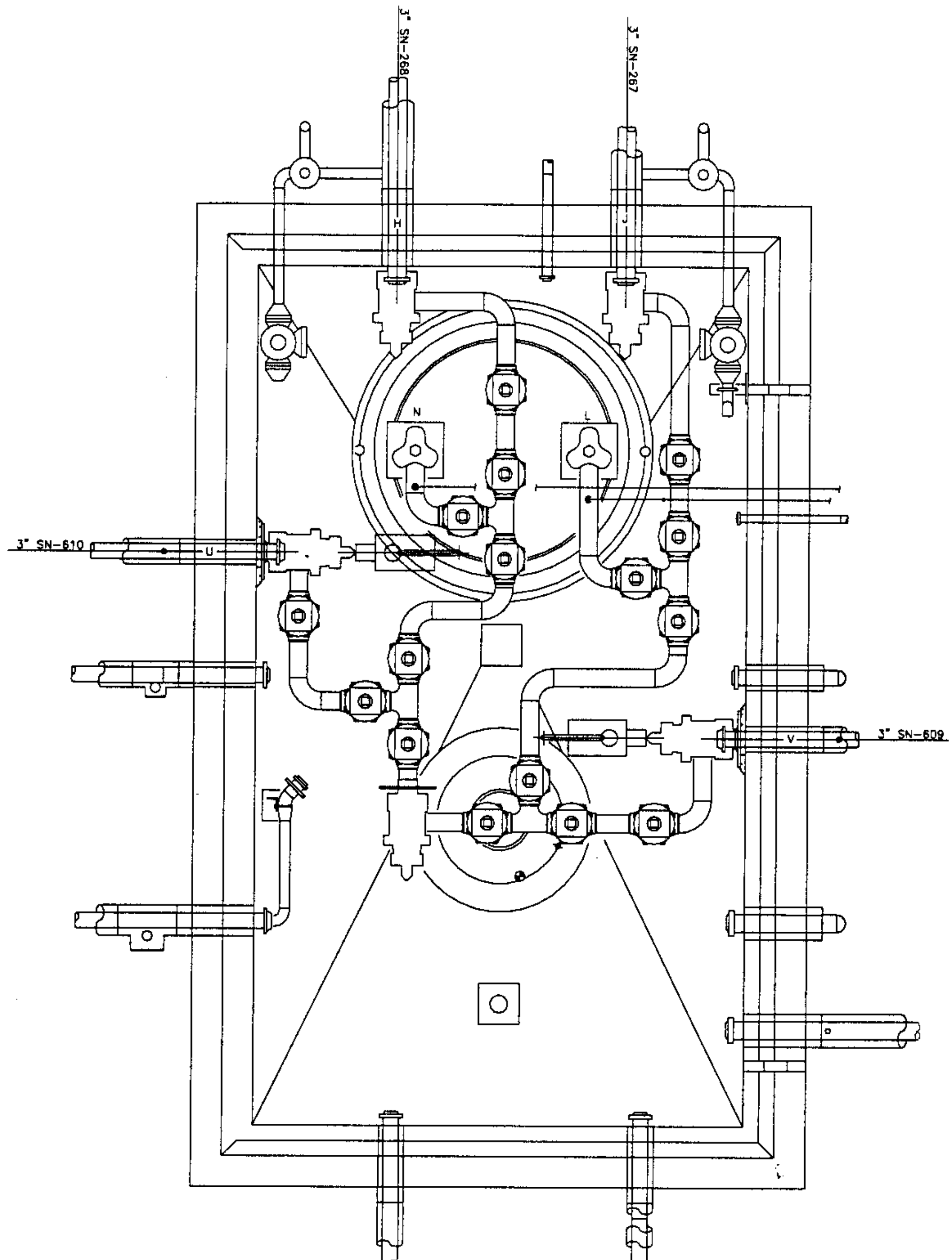

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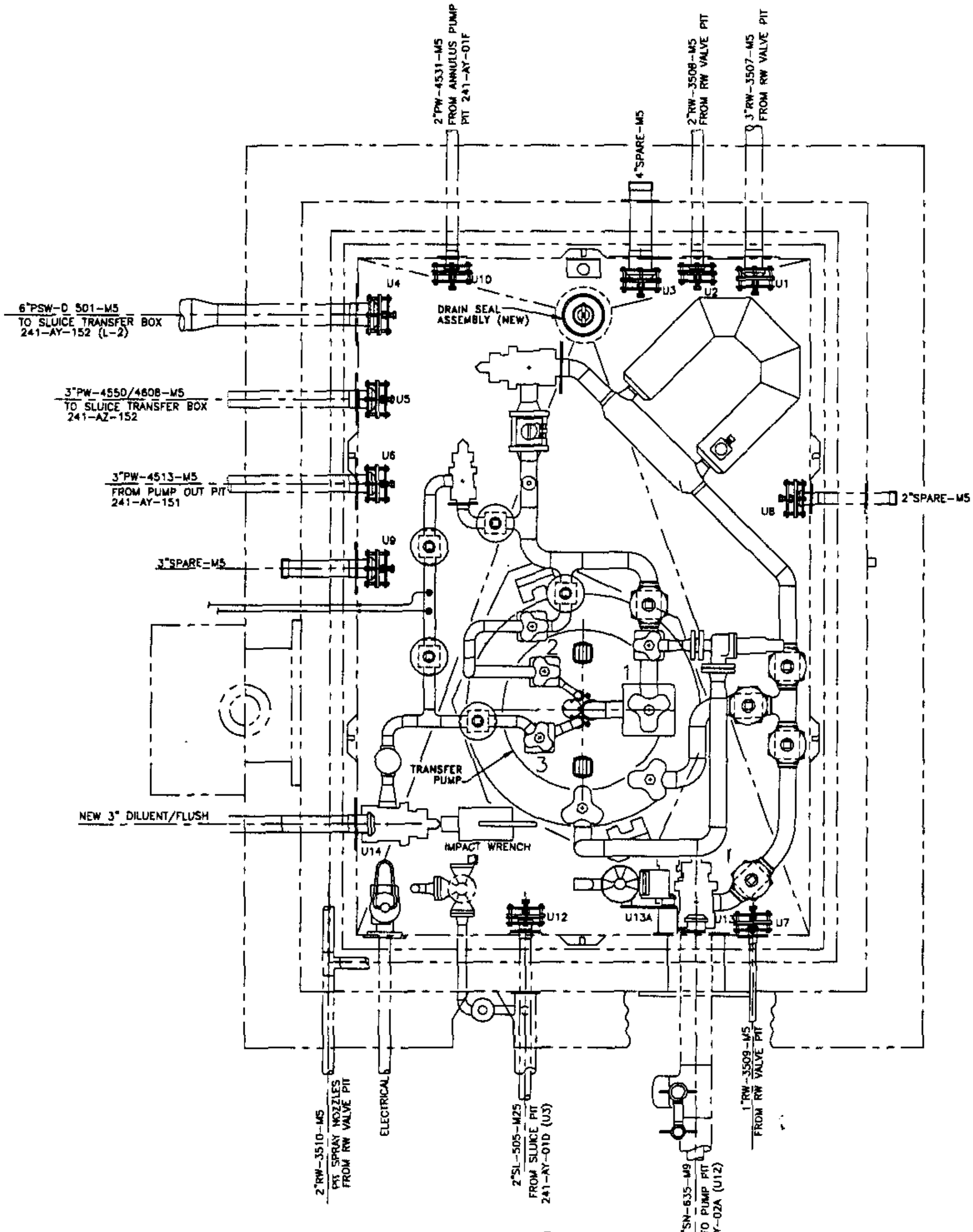

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CENTRAL PUMP PIT
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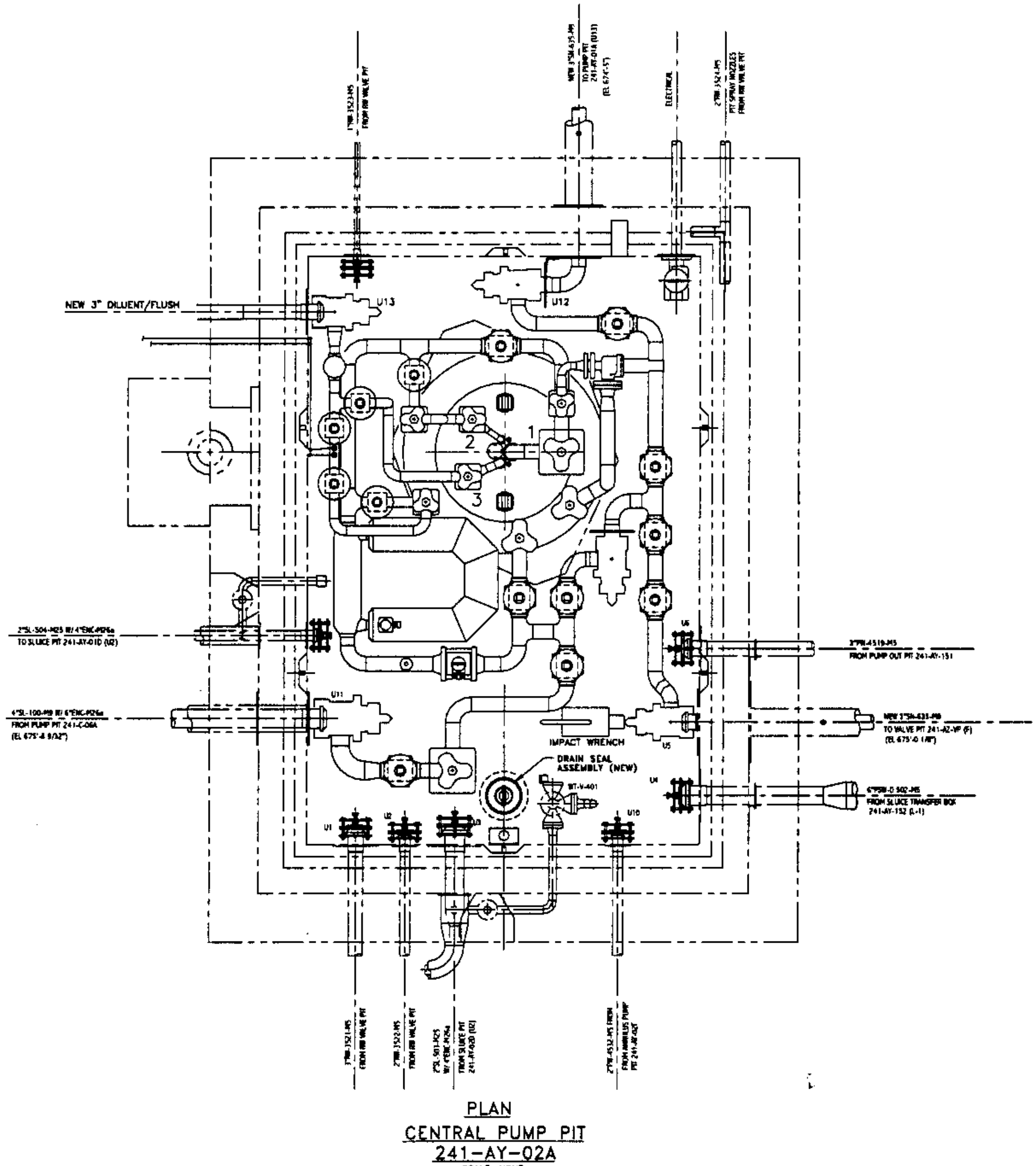

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CENTRAL PUMP PIT
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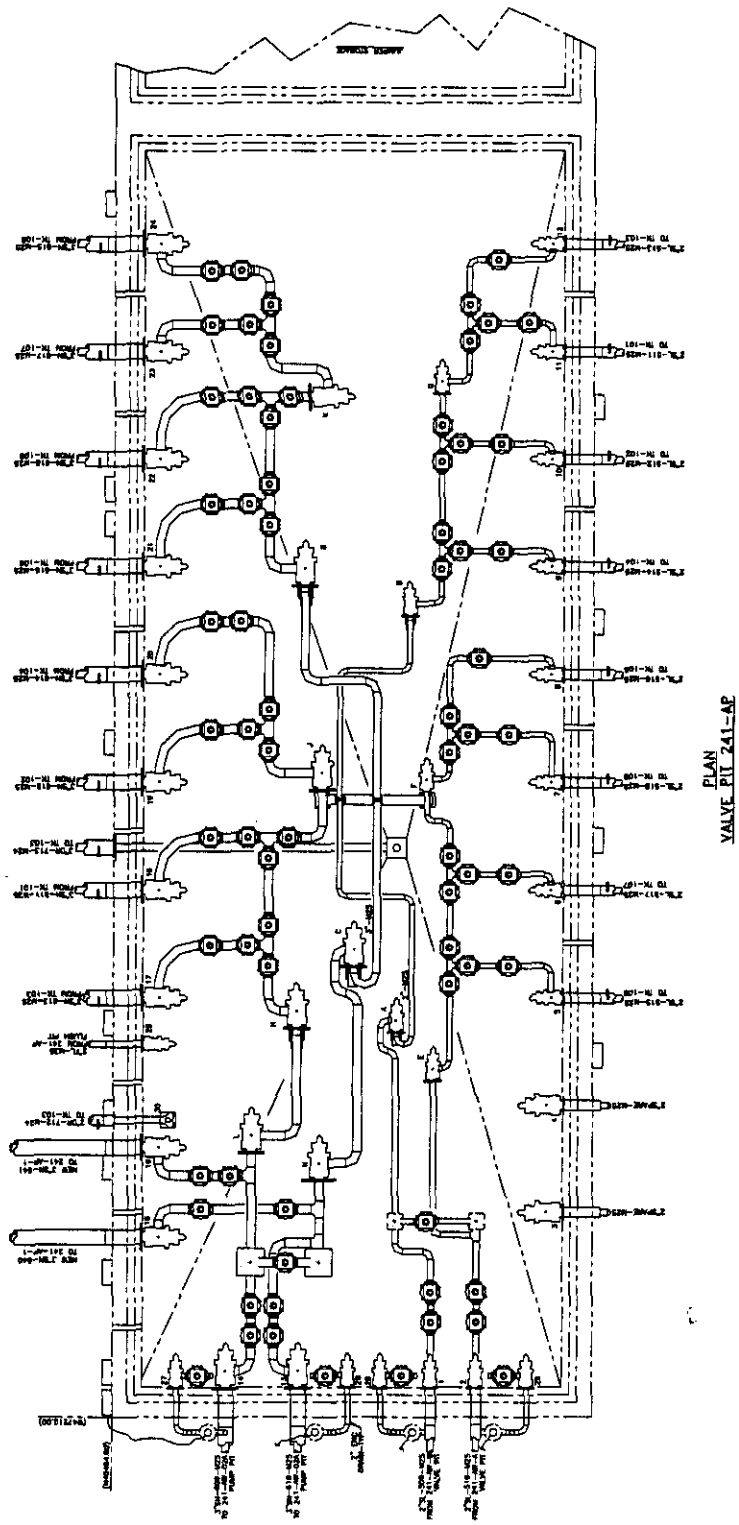
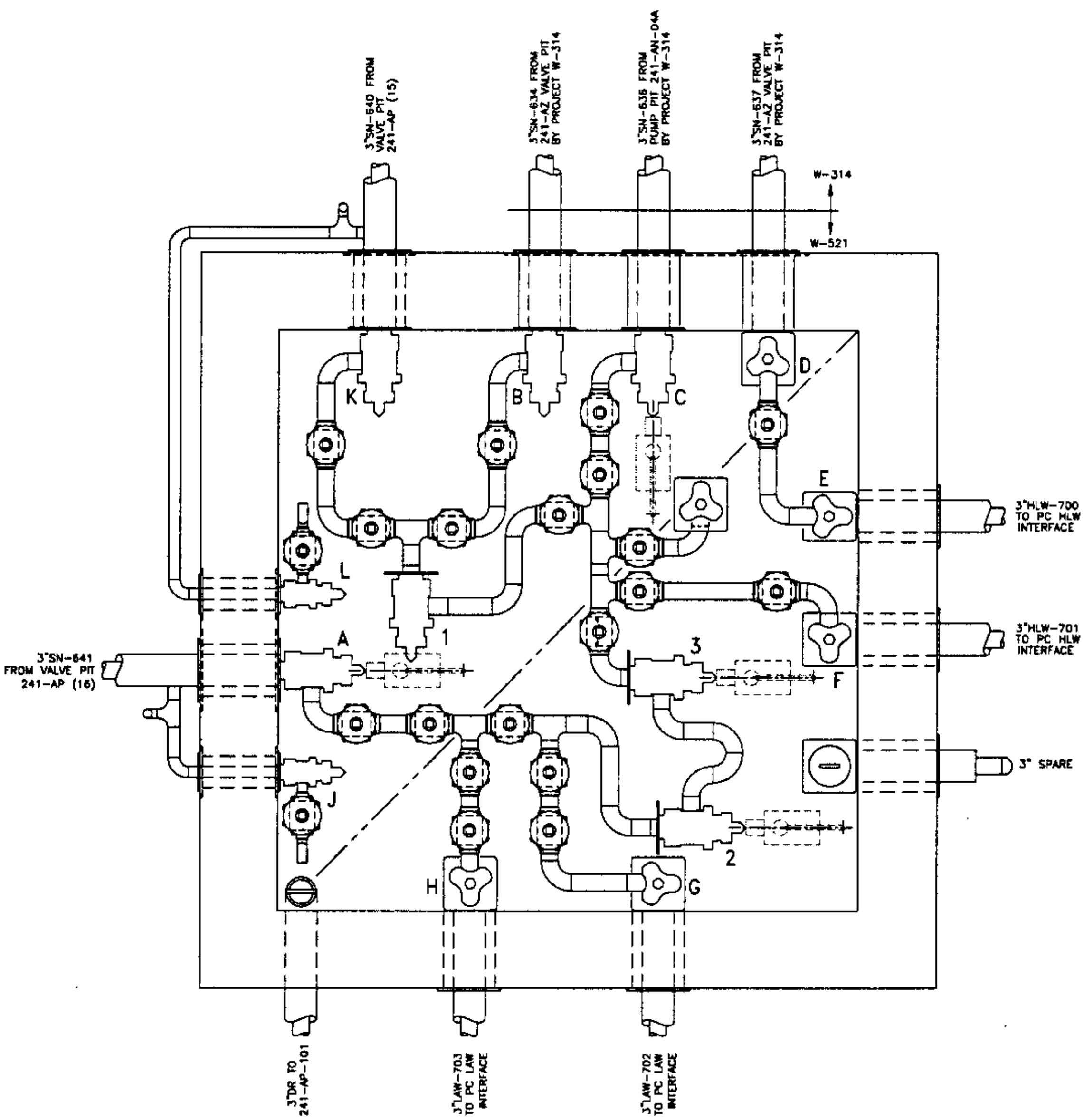
(SHOWN WITH COVER BLOCKS REMOVED)

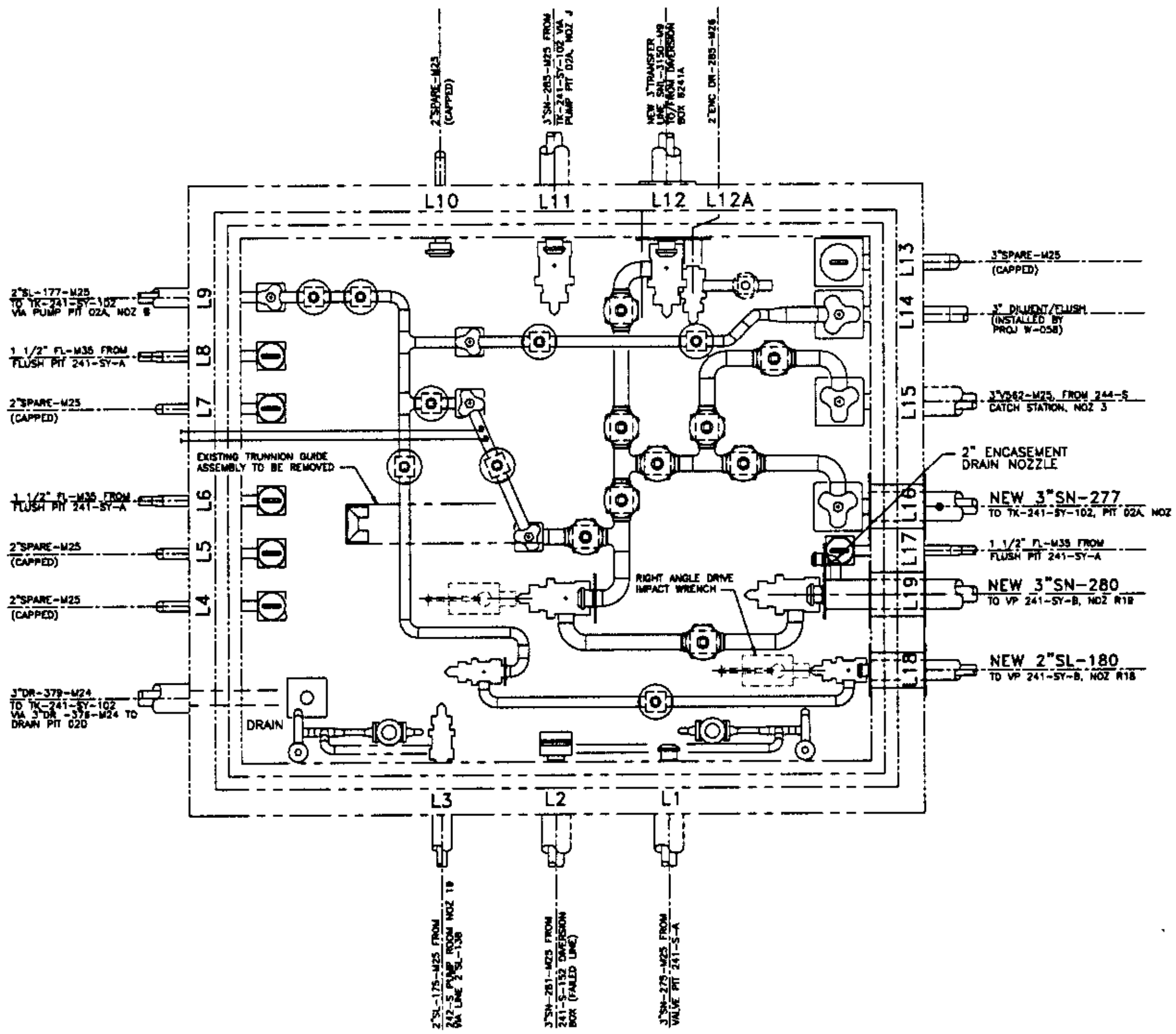

PLAN
VALVE PIT 241-AP



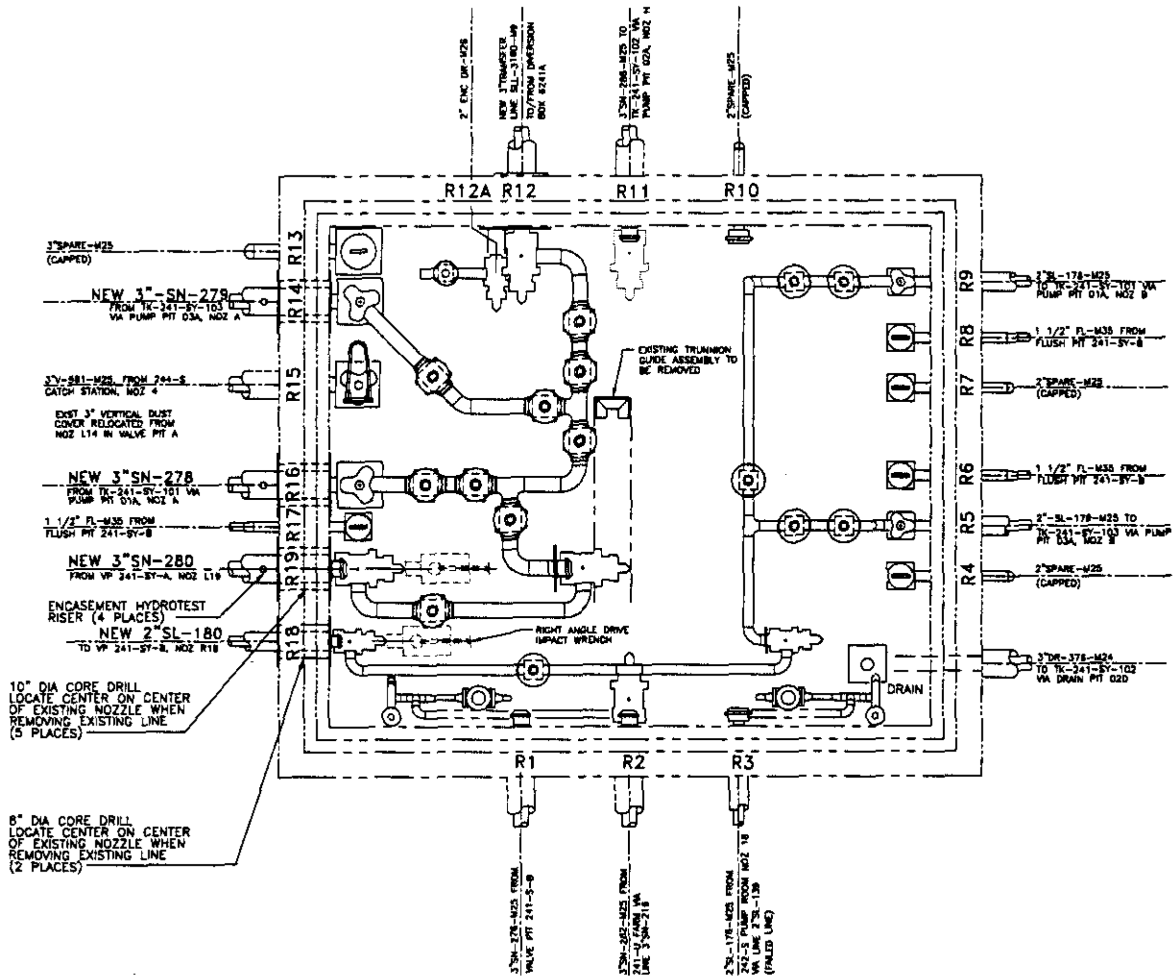
PLAN VIEW

NEW VALVE PIT 241-AP-A

COVER BLOCKS NOT SHOWN



PLAN
VALVE PIT 241-SY-A
SCALE: NONE



PLAN
VALVE PIT 241-SY-B
SCALE: NONE

Attachment B

Attachment B

Mixer Pump Impingement Force on In-Tank Equipment

MIXER PUMP IMPINGEMENT FORCE ON IN-TANK EQUIPMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46
Report No. 990920203-015
ACDR Subtask 2

Revision 0

September 2000

prepared by

HND TEAM

MIXER PUMP IMPINGEMENT FORCE ON IN-TANK EQUIPMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

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Prepared by: Denise Clements
Stephen D. Riesenweber
Kristyn L. Clayton

Approved by: ______________________
Robert L. Fritz

Date: ______________________

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Acronyms

AISC	American Institute of Steel Construction
ALC	Air-Lift Circulators
ASME	American Society of Mechanical Engineers
ALC	Airlift Circulator
CDR	Conceptual Design Report
HND	Holmes and Narver/DMJM
MIT	Multi-Function Instrument Tree
Sy	Yield Stress
VDTT	Velocity Density Temperature Trees

1.0 INTRODUCTION

This analysis was prepared as a part of the Advanced Conceptual Design for Project W-521. One element of the project involves the use of mixer pumps to mobilize solids in the tank and agitate the tank contents to produce a uniform mixture.

It has been determined through previous analysis that a configuration using two mixer pumps (approximately 300 hp each) is the best method to accomplish tank mixing. The mixer pumps use opposing horizontal exit jets that slowly rotate about the pump's vertical axis. The jet force criteria have been provided to the project as the product of the mixer pump nozzle exit velocity and the nozzle diameter (termed U_0D). A U_0D value of 29.4 ft^2/s has been established. Typically, 6-in. nozzles are specified with a resulting exit velocity of approximately 59 ft/sec. Due to the high energy discharged from the pumps, care must be taken to ensure that the jets do not produce excessive forces on other in-tank components.

Concern exists from previous analysis and testing that has prompted study of the resulting forces in tanks from mixer pump operation. The major areas of concern for the forces arising from mixer pump operations include: 1) the damaging effect of the forces on operating components, 2) the resulting permanent damage to equipment that will affect future operations (i.e. thermocouple tree bending or breaking so as to prohibit removal and possibly cause interference with other in-tank component operation), and 3) resulting damage to the tank structure itself (i.e., moment arm or fatigue breaking of a riser or tank weld).

1.1 Purpose

This evaluation addresses the issues associated with forces applied to tanks and equipment within the scope of Project W-521 due to mixer pump installation.

The purpose of this analysis is to assure that the project mission is not adversely affected by mixer pump operation. This task is accomplished by evaluating the equipment that is in close proximity to the pumps for any detrimental stresses and fatigue caused by the force of the jet stream from the nozzle. Mixer pump impingement forces experienced by in-tank components are analyzed to establish, at a conservative conceptual level, the components that require removal or special operational controls. Forces on the tank walls and on components near the tank walls are analyzed as well to ensure that tank integrity is maintained.

1.2 Scope

The scope of this task is to evaluate existing and new equipment to be installed by Project W-521 in tanks AW-101, AW-103, AW-104, AY-101, AY-102, SY-101, SY-102, and SY-103. Within scope is any item that extends below the tank waste level that could be affected by mixer pump operation. Components evaluated include transfer pumps, temperature trees, multi-function instrument trees (MITs), velocity density temperature trees (VDTTs), air-lift circulators (ALCs), and drain pipes.

2.0 METHODOLOGY

The approaches used to identify potentially affected tank components and analyze the risks to each are as follows:

- Components that currently are, or are planned to be, installed in each tank riser are identified. For each component, critical physical characteristics and needed analytical parameters are established.
- A determination is made as to which components can be eliminated from detailed analysis based upon previous analyses and proximity of like components.
- Impingement force yield stress, plastic hinge deflection, and fatigue analyses are performed on identified components in order to:
    - Estimate potential yield forces experienced by in-tank equipment,
    - Estimate potential plastic hinge deflection values for equipment,
    - Estimate fatigue failure for equipment, and
    - Determine the allowable forces for the various components.
- Components that may be vulnerable to excessive stress are identified and a determination is made to:
    - Identify the equipment that may require removal or replacement, and
    - Identify potential controls (i.e. pump operating speed) necessary to mitigate the effects of the jet forces.

3.0 ASSUMPTIONS

The overall assumptions made for this evaluation are based primarily upon past impingement force analyses [HNF-SD-W151-DA-008, *Evaluation of the Effect of Project W-151 Mixer Pump Jets on In-Tank Equipment Considering Potential Sludge Build-up on Equipment in Waste Tank 241-AZ-101, Hanford Site, Washington* (Julyk 1997] performed on AZ-101 tank components.

The assumptions are as follows:

- The basic force developed on the components from mixer pump operation is the drag force on a solid body in a flowing fluid with uniform distribution as assumed in the Julyk (1997) report.
- A 3.5-in. radial sludge buildup layer is appropriate to addition in equipment diameter for purposes of diameter calculations. This value was chosen from the Julyk (1997) report that analyzed several components in tank AZ-101 for force effects based on mixer pump operation.

This report stated that AZ-101 thermocouple sludge thickness did not exceed 2.5-in.; however, 3.5-in. was used as a conservative value.

- Appropriate flow rates were estimated at 70 percent and 100 percent pump speeds as estimated by a pump manufacturer. This assumption was necessary since final pump curves will not be available until the pump is procured per specifications prepared in the Definitive Design phase of this project. At that time the 70 percent pump speed and associated flow rate should be reviewed and these calculations revised to provide a final determination of the operational controls that may be necessary to minimize the effects from impingement forces.

- The ALC thermowells are all anchored at the bottom of the ALC, as indicated on construction drawings, thus creating a moment arm of approximately 27-in.

- The AISC allowable yield value of 0.66*Sy for A53, Grade A carbon steel is acceptable as the allowable stress for critical equipment which is required to remain undamaged during and after mixing. The yield stress, Sy, is used to calculate the maximum allowable force for components that will not be operational during mixing activities and will not have an adverse effect on operations or project activities if slightly bent.

- Calculations based on static analysis, with dynamic load factors applied to allowable stress values, are acceptable.

- Similar mixer pump components and characteristics, such as the expected equivalent nozzle parameters (exit velocity and nozzle diameter, $U_oD_o = 29.4\ ft^2/s$ and 6-in.) as well as general mixer pump properties, are acceptable for all tanks.

- Worst-case waste properties are a waste viscosity of 30 centipoise and density of 1.4 g/cm^3.

- Two, three hundred horsepower mixer pumps will be installed in all tanks.

- The dynamic factor applied and the values of force used conservatively accommodate the vortex forces and the uplift on the component discussed in other analyses.

4.0 DISCUSSION

Julyk (1997) predicted the mixer pump impingement forces and deflections experienced by equipment in tank AZ-101. Early in 2000, mixer pumps were tested in the AZ-101 tank, and the in-tank camera observed expected deflection of the drywell in riser 14A, indirectly confirming the prediction made by the report. This verified correlation was used as the basis for analysis in this report.

The AZ-101 analysis was performed on a tank with approximately 15-in. of solids on the tank bottom. It was fully inserted into the tank and operated. However, tanks within the scope of Project W-521 have residual solids levels much higher, with some projected to have sludge as deep as 125-in. Figure 4-1 provides a sectional representation of tank AY-101 with a high solids level. Past experience with the installation of mixer pumps into deep sludges at the Savannah River Site confirmed that pumps should not be fully inserted into the solids and then started. The sludge can block and plug the pump suction. As a result, it has been determined that the pumps will be lowered into the tank until their suction is slightly above the sludge and then run in that position until a radius has been cleared around the pump. The pump will then be lowered until its suction approaches the sludge and run again. This process will be repeated until the pump is fully inserted. Thus, this analysis must consider the impact on tank components as it is being incrementally lowered into the solids level.

4.1 Component Identification

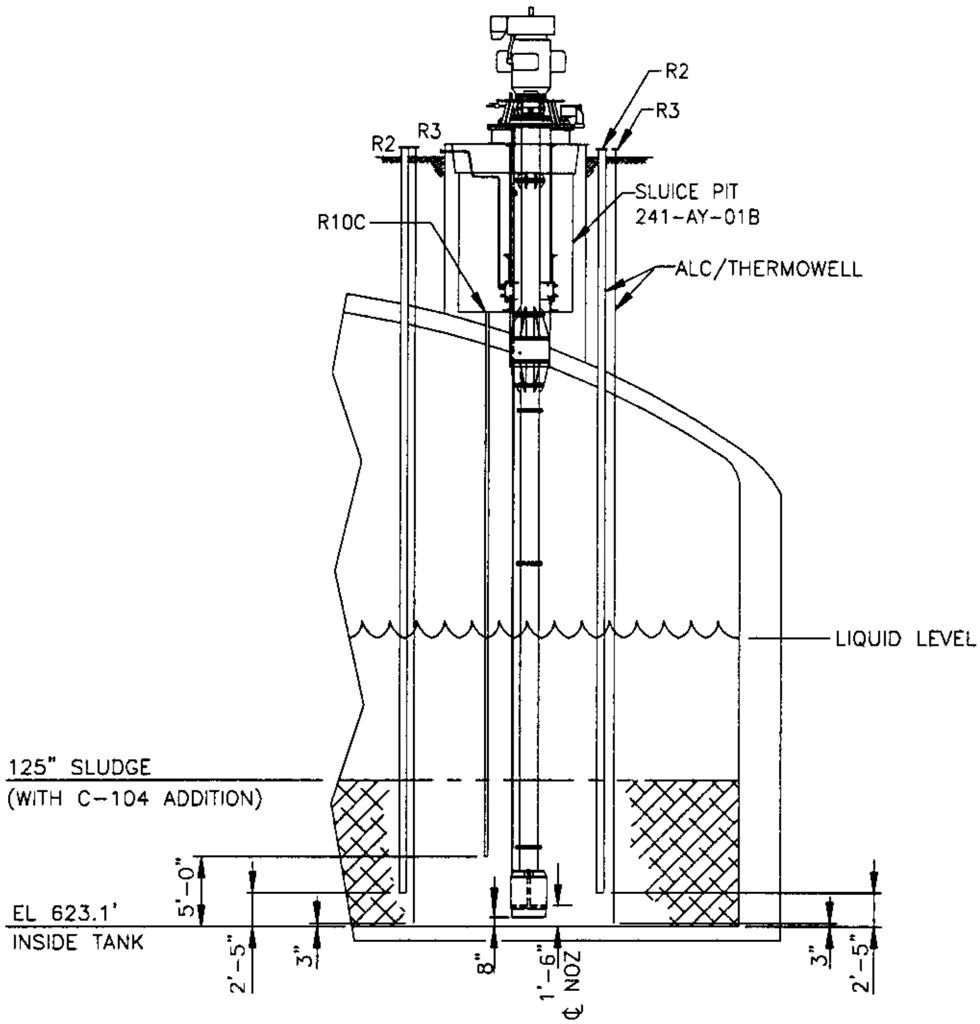
Appendix A includes a listing of the tank components, locations, and distances from the component to the mixer pump jet. It was decided to analyze all components in the tanks that could cause a detrimental affect on the mixing and pumping operations due to exceeded yield stress or plastic hinge deflection limit loads. These components were analyzed based on their ability to deflect significantly thus impacting other components, disturb the tank walls, deflect so that they cannot be removed, or deflect so that operation becomes impaired.

Figure 4-1 is a typical section of a mixer pump installed in a tank. Figures 4-2 through 4-9 show all subject tanks with components of concern located. Components that are to be removed from the tanks for reasons other than mixer pump impingement forces (i.e., riser needed for another component) are not shown. From the commonality between equipment and the similar or bounding installed locations within the tank, conclusions are drawn with respect to identification of components requiring analysis. A discussion of the analyzed components is contained in section 4.2.2.

4.2 Analysis Approach

This analysis is based on the approach developed in Julyk (1997) which presents a model for the relationship of a constant drag force applied to submerged tank components (cylindrical pipes or tank walls) as a function of distance from the nozzle exit of a pump. The developed relationships are dependent on known or assumed fluid properties (density, specific gravity, viscosity), pump characteristics (nozzle exit velocity, nozzle exit diameter, rotating rpm), and submerged component configuration (distance, diameter). This analysis uses the same equations for drag force and plastic hinge deflection that were used to analyze the components in the AZ-101 tanks. It applies to all components in the scope of Project W-521.

For the purpose of this conceptual analysis, calculations are not performed to estimate forces due to increased waste velocity along the tank bottom. This is considered to the adequately covered by applying the load to components as a point load acting at the bottom end of components rather than at the nozzle centerline (See Appendix B, Calculation ME-07).



RISER ID	FUNCTION	SIZE	DIST TO NOZ (FT)
R2	AIR LIFT CIRCULATOR	6"	7.2
R2	AIR LIFT CIRCULATOR	6"	10.6
R3	THERMOCOUPLE FOR AIR LIFT CIRC	3/4"	7.7
R3	THERMOCOUPLE FOR AIR LIFT CIRC	3/4"	10.2
R10C	SLUICE PIT DRAIN	3"	2.7

Figure 4-1. Section and Elevation of Pump Riser in Tank AY-101.

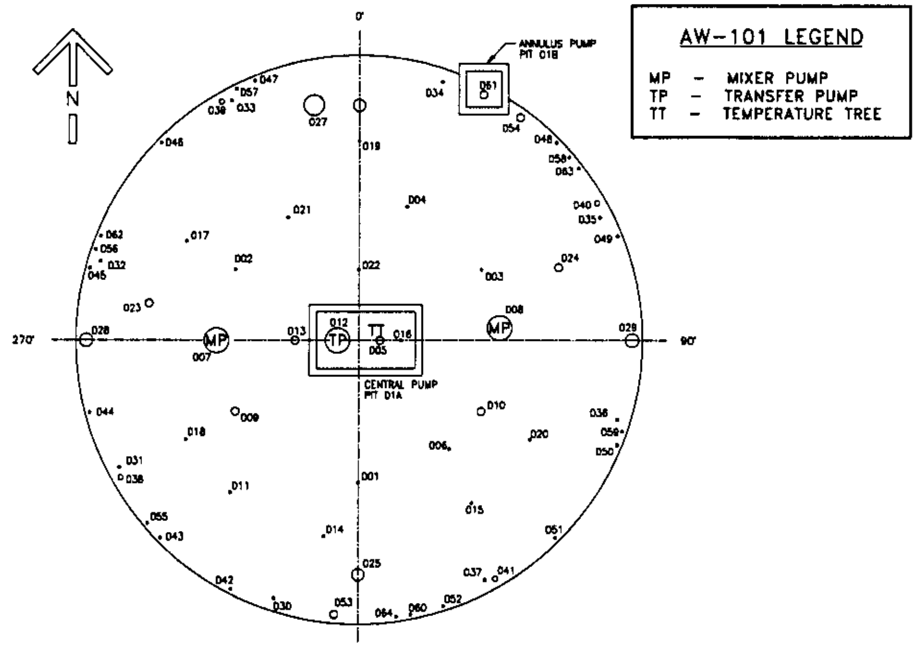


Figure 4-2. AW-101 Plan View.

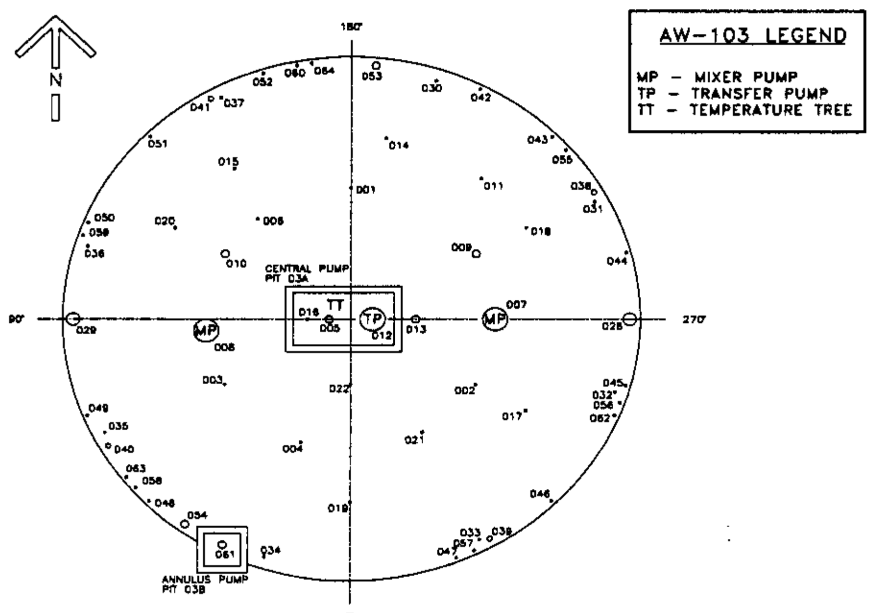


Figure 4-3. AW-103 Plan View.

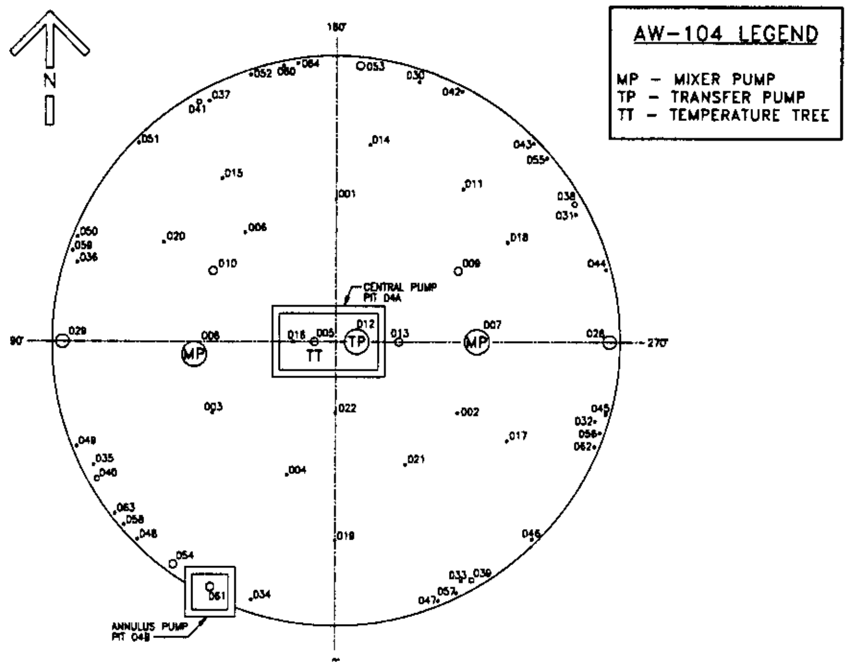


Figure 4-4. AW-104 Plan View.

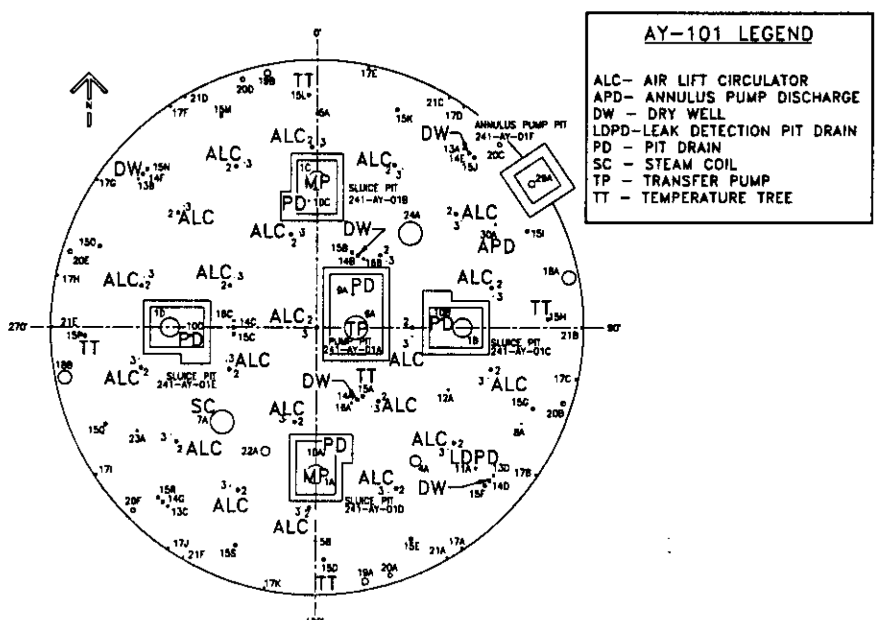


Figure 4-5. Riser Configuration of Tank AY-101.

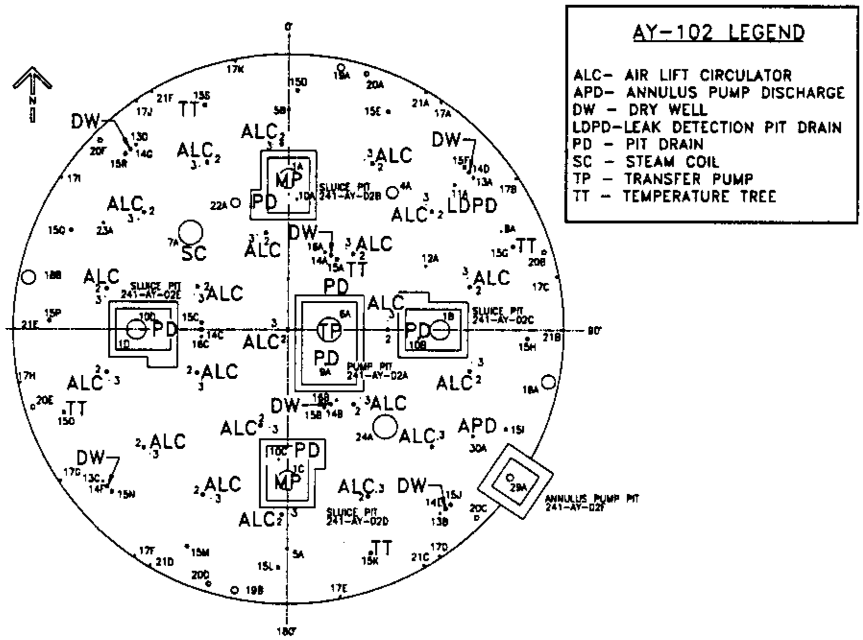


Figure 4-6. Riser Configuration of Tank AY-102.

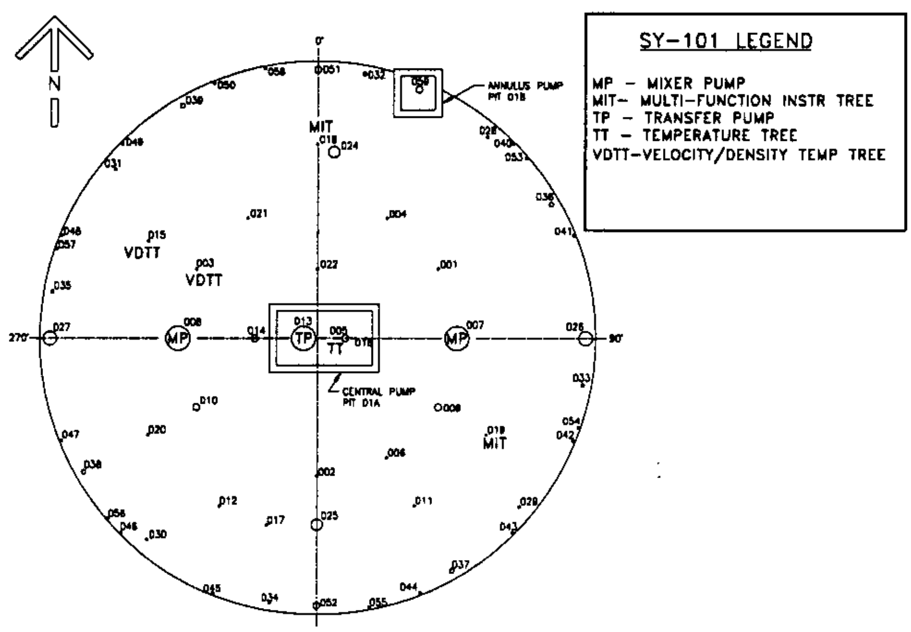


Figure 4-7. SY-101 Plan View.

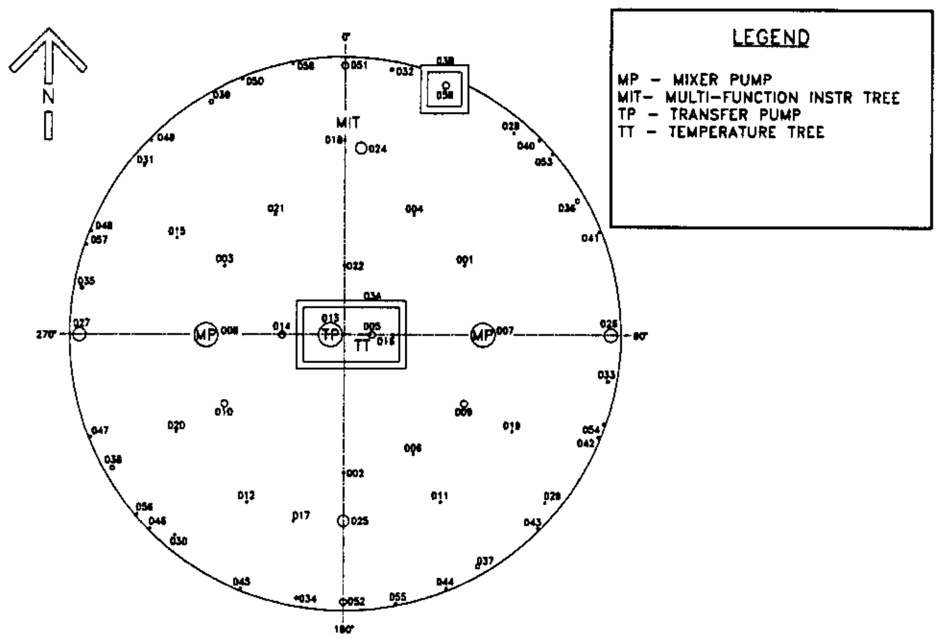


Figure 4-8. SY-102 Plan View.

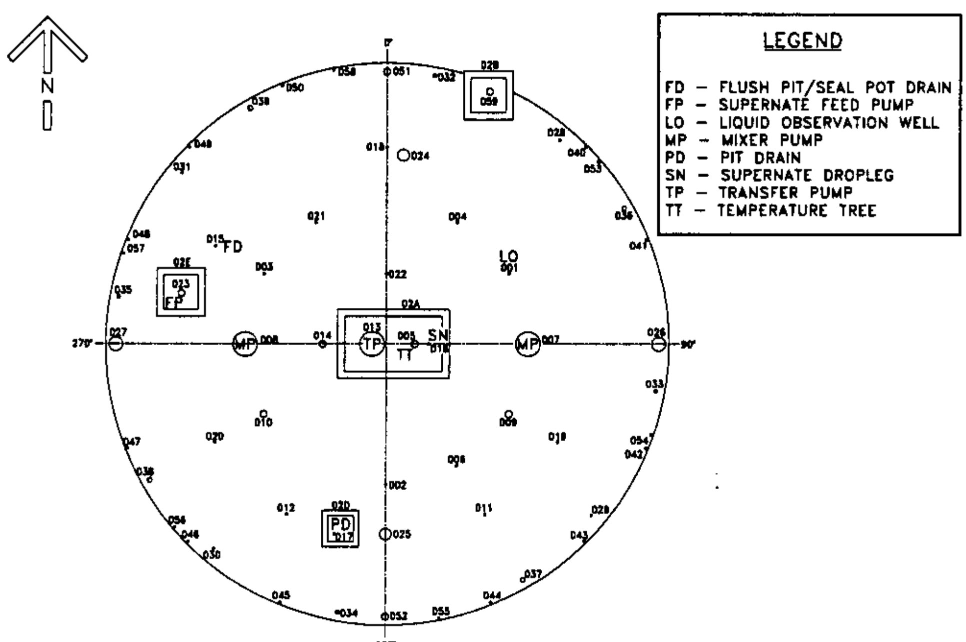


Figure 4-9. SY-103 Plan View.

4.2.1 Mixer Pump Design Considerations

HNF-4164, Revision 0, *Double-Shell Tank Mixer Pump Subsystem Specification* (Shaw 2000), specifies a lower limit on the product of the nozzle exit velocity and diameter, to promote adequate fluid mixing, in the form of

$U_oD_o = 29.4$, ft^2/s (1)

Where Do is the nozzle diameter and
U_o is related to the actual pump flow rate, Q, by

$Q = (\pi U_o N/4)\, D_o^2 C_V C_m$, gal/min (gpm) (2)

Where N = Number of nozzles
$C_V = 7.48$ gal/ft^3
$C_m = 60$ sec/min

Substituting in U_o and solving for D_o in terms of Q gives

$D_o = (4Q)/[\pi(29.3)NC_VC_m]$, ft (3)

4.2.2 Component Considerations

The following components were analyzed for various reasons as stated:

- The new transfer pumps were analyzed for two sizes that are being considered – an 11" and a 32" because of their close proximity to the mixer pumps. Deflection on the pump shaft might detrimentally affect the pump operation if the pump is line-shaft driven.
- The new thermocouple trees are necessary for operation.
- The ALC and ALC thermowells are not needed for future operations; however, in some cases, they are very close to the mixer pumps and could cause a shadowing affect on the mixing effectiveness or deflect enough to impair mixing operations. ALCs are welded into the AY tanks so they are not removable.
- The sluice pit drains are welded permanently to the tank structures and are in close proximity to the mixer pumps.
- Drywells in the AY tanks are in close proximity to mixer pumps and were known to have impingement force problems in 101-AZ testing.
- The Leak Detection Pit Drain is close to the tank wall and if deflected significantly could impact the wall.

- Two Velocity Density Temperature Trees in SY-101 are in close proximity to the mixer pumps. They are operational but not critical to the future mission.
- The Multi-Function Instrument Temperature Trees (MITs) were relatively close to the mixer pumps and could deflect significantly.
- The tank wall (located a distance of 15.5 ft. from the pumps) was analyzed to assure that mixer pumps do not pose a risk to the tank containment system integrity.

Two pump speeds were used for force evaluations. The 70 percent flow value was provided by a pump manufacturer (Sulzer Pumps) as an estimate and will need to be reviewed after establishment of the final pump curves. For the 70 percent pump speed, the results are based on an estimated volumetric flow rate (reduced from 11.54 cu. ft/s at full speed to 6.0 cu ft/s as estimated by Sulzer pump manufacturer). This ratio (52 percent) results in a reduction of U_oD_o from the design value of 29.4 ft^2/sec to 15.29 ft^2/sec based on the assumption that the flow area (and thus D_o) remains constant, so U_o varies proportionately.

Figure 4-1 provides a composite elevation of tank AY-101 at one mixer pump that is representative of all AY Tanks. As can be seen, the mixer pump nozzle centerline is located 19-in. above the tank bottom. But, since the mixer pumps will be incrementally lowered while operating (to facilitate insertion into deep sludges), force analysis was performed on all components with the entire jet force applied at the maximum bending moment for each component.

Following is a brief summation of the analytical methods used to calculate forces on components and references. For the detailed calculations, see Appendix B.

4.2.3 Constant Drag Force

The basic equation for the drag force on a solid body in a flowing fluid with uniform distribution is given by:

$$F_d = {}^1/_2\, \rho\, U^2 A\, C_d / g_c\,,\ lb_f \qquad (4)$$

Where: ρ = fluid density, lb_m/ft^3
U = Free stream velocity, ft/s
A = Projected area, ft^2
C_d = Drag Coefficient, unitless
g_c = gravitational conversion factor, $lb_m\text{-}ft^2/lb_f\text{-}s$

4.2.4 Jet Free Stream Velocity

The centerline velocity of a free momentum jet in a liquid (unperturbed by, for example, a tank bottom), at a downstream distance z from the jet discharge, is given by Trent, 1994 as:

$$U_{cl}(z) = kU_oD_o/z\,,\ ft/s \qquad (5)$$

Where,

U_o = Jet discharge velocity, ft/s
D_o = Jet nozzle discharge diameter, ft
k = The diffusion coefficient for the jet flow unitless
z = Distance from jet discharge to point of reference, ft

The velocity decreases radially from the jet centerline axis (z) and is given by

$$U(r,z) = U_{cl}(z) \exp[-K(r/z)^2] = (kU_oD_o/z) \exp[-K(r/z)^2], \text{ ft/s} \quad (6)$$

Where,

$$K = \text{Flow momentum constant} = 2\,k^2, \text{ unitless} \quad (7)$$

The jet discharge velocity, U_o can be determined from the actual pump flow rate Q (ft^3/s) divided by the total pump exit nozzle area A_o (ft^2), or

$$U_o = Q/A_o, \text{ ft/s} \quad (8)$$

$$\text{where } A_o = N\pi(D_o/2)^2, \text{ ft}^2 \quad (9)$$

and N = number of pump nozzles.

4.2.5 Radial Flow Distribution

Let U_R = the dimensionless ratio of the local velocity, U(r,z) and the maximum (centerline) jet local velocity, $U_{cl}(z)$, or

$$U_R = U(r,z)/U_{cl}(z), \text{ unitless} \quad (10)$$

This gives an effective boundary radius of the nominal jet given by Trent, 1994 and Fargo, 1999 as

$$r_{max}(z) = z\,[-(\ln U_R)/K]^{1/2} + D_o/2, \text{ ft} \quad (11)$$

Where, as before, the flow momentum constant K is defined in terms of the diffusion coefficient to be

$$K = 2k^2, \text{ unitless} \qquad \text{Bamberger, 1990 and Fargo, 1999} \quad (7)$$

From a practical standpoint, the effective jet radius boundary at a distance z downstream is typically chosen to be where the velocity ratio U_R is equal to 0.1, or 10% of the maximum jet centerline velocity, according to Trent, 1994.

Where ν is the kinematic viscosity of the fluid and is equal to the absolute viscosity μ divided by the fluid density ρ, or,

$$\nu = \mu/\rho \quad \text{in } ft^2/s \tag{12}$$

In this analysis, the Trent expression for r_{max} will be used since this gives the largest radius.

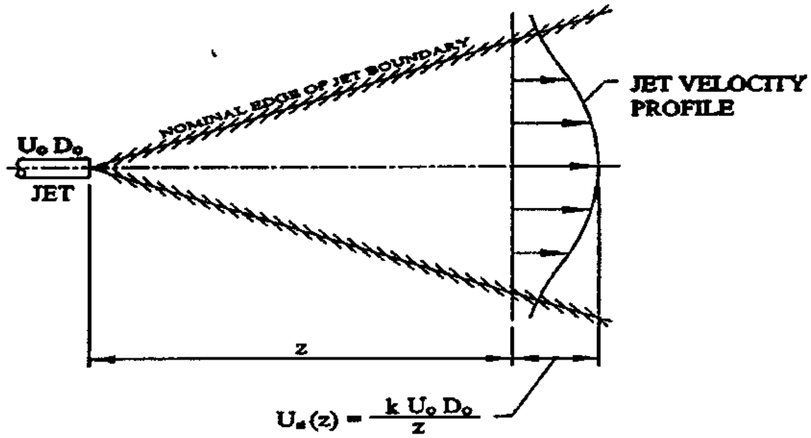


Figure 4-10. Effective Radius.

4.2.6 Drag Force on Vertical Pipe Component

For the condition with a diverging jet flow impinging upon a component, a non-uniform flow exists, (i.e., where the flow velocity varies with location on the projected area of the component). The equation for the drag force (1) under these conditions becomes:

$$F_d = [{}^1/_2\ \rho/g_c] \int_A U^2 C_d\, dA\ ,\ lb_f \tag{13}$$

Putting area A of this equation in the terms of the coordinates (horizontal x and vertical y), both perpendicular to the flow axis direction (z) gives,

$$F_d = [{}^1/_2\ \rho/g_c] \int_{-y}^{+y} U^2(x,y)\, C_d(x,y)\, dxdy\ ,\ lb_f \tag{14}$$

For a component modeled as a pipe of fixed diameter D_p, this becomes:

$$F_d = [{}^1/_2\ \rho/g_c]\, D_p \int_{-y}^{+y} U^2(y)\, C_d(y)\, dy\ ,\ lb_f \tag{15}$$

U(y) is the fluid velocity profile along the axis of the pipe and –y to +y are the integration limits for the impinged pipe length. The pipe diameter is assumed small compared to the variability of the flow velocity (assumed constant velocity over width of pipe diameter).

The drag coefficient $C_d(y)$ is a function of Reynolds number, Re(y), which in turn is a function of the local flow velocity U(y), at the pipe component axial location y, or

$$Re(y) = U(y)D_p/\nu = \rho U(y)D_p/\mu \text{ , unitless} \qquad (16)$$

4.2.7 Local Flow Velocity at Component

For an in-tank component a fixed distance z_p from the nozzle exit, equation (6) becomes

$$U(r,z_p) = U_{cl}(z_p)\exp[-K(r/z_p)^2] = [kU_oD_o/z_p]\exp[-K(r/z_p)^2] \text{ , ft/s} \qquad (17)$$

For a jet centered on the vertical axis of the component, the maximum drag force is given by

4.2.8 Drag Coefficient

In order to perform the numerical integration, $C_d(Re)$ needs to be expressed in a functional form. The drag coefficient, $C_d(Re)$, is given empirically, Trent, 1994 as a function of the Reynold's number to be

$$\log_{10}[C_d(Re)] = [0.75 - \log_{10}(Re)]\{0.5 - \tan^{-1}[0.24(\log_{10}(Re))]/\pi\} + 0.52 + a + b + c \qquad (18)$$

Where $a = 0.45\exp\{-0.32[\log_{10}(Re) - 3.35]^2\}$ (19)

$b = 0.69\exp\{-1.40[\log_{10}(Re) - 4.80]^2\}$ (20)

$c = 0.34\exp\{-7.00[\log_{10}(Re) - 5.40]^2\}$ (21)

Expression (21) is stated by Trent, 1994 to be accurate to within ± 8% over the range of Re from $0.1 \le Re \le 4\times10^5$. $C_d(Re)$ is easily obtained as the anti-log to the base 10 of $\log_{10}[C_d(Re)]$. This value is then related to $C_d(y)$ and used in equation (13).

4.2.9 Effect of Sludge Buildup

Within the limits of this analysis, sludge buildup on in-tank components is assumed to be uniform over the component length within the effective jet flow region. With this assumption, the effect of sludge buildup is to increase the effective diameter of the pipe.

Julyk (1997) presents the component effective diameter with sludge buildup as:

$$D_p = D_c + 2T = D_c[1 + (2T/D_c)] \text{ , ft} \qquad (22)$$

Where T is the assumed uniform sludge buildup thickness in the same units as D_c, and as before D_c is the clean component diameter.

4.2.10 Wall Force

The equation for the force on the tank wall for a uniform (constant) velocity distribution is given by

$F_w = (\rho/2g_c)\, U^2\, A,\ lb_f$ (23)

For a non-uniform velocity distribution [U(r,z)], the equation becomes

$F_w = (\rho/2g_c) \int_A U(r,z)^2\, dA,\ lb_f$ (24)

Since $A = \pi\, r^2,\ ft^2$ (25)

$dA = 2\pi\, r\, dr,\ ft^2$ (26)

Defining r_{max} to be a function of z is [repeated here],

$r_{max}(z) = z\,[-(\ln U_R)/K]^{1/2} + D_o/2$, ft (11)

$U_R = 0.1$, or 10% of maximum to define effective circular flow area boundary.

The equation for $F_w(z)$ then becomes

$F_w(z) = (\pi\rho/g_c) \int_0^{rmax} U(r,z)^2\, r dr$, lb_f (27)

Substituting in equation (6) for U(r,z) this becomes

$F_w(z) = (\pi\rho/g_c)(kU_oD_o/z)^2 \int_o^{rmax} \exp[-2K(r/z)^2]\, r dr$, lb_f (28)

This is plotted in the attached calculation (Appendix B) where z is the variable distance from the nozzle exit to the wall, in feet. It is interesting to note that the force on the wall varies little as a function of z, within the limits of the calculations, due to conservation of momentum effects.

4.2.11 Yield Stress Analysis

The A53, Grade A carbon steel yield value (Sy) was used for non-critical components. The AISC allowable (.66 Sy) was used to analyze the components which were critical to the operations or which were of major concern. This will provide a more conservative approach to critical components while assuring that non-critical components do not break and fall into the tank, bend to the point that they cannot be removed, or damage other equipment.

The yield strength calculations are applied using solid cross sectional areas of various diameter carbon steel pipes while the plastic hinge deflection calculations are applied using the shape cross sectional area for the respective pipes. Appendix B - Calculation ME-07 presents these results in their entirety.

The specific components of concern are the airlift circulator (ALC) thermowells, sluice pit drains, and all new thermocouple trees. AY-101 Farm impingement forces were analyzed since they represent the bounding case for both AY-101 and AY-102. SY-101 bounded several components in the other tanks and the individual tank components from SY-102 and SY-103 were also analyzed. AW-101 components were the bounding cases for AW-103 and AW-104. The tank wall was analyzed for AY-101 since the mixer pumps are closest to the wall in that tank. Refer to Figures 4-2 through 4-9 for riser configurations and component locations in each of the tanks. Section 4.3 summarizes the results of this analysis.

4.2.12 Plastic Hinge Limit Deflection

The components of concern for this analysis are the equipment that could: 1) impact the tank wall upon deflection, 2) impact other pieces of equipment that are critical to tank operations, or 3) deflect significantly and thus reduce their effectiveness. Since very few components exceeded their yield stress at 70 percent or 100 percent pump speed, the determining criteria became the plastic hinge limit deflection. This was a slightly more conservative analysis approach than yield stress and used the shape cross sectional area to compute the forces. All of the components were analyzed for deflection. The same yield stress values were used as in the yield stress calculations.

The worst-case deflection for each component is presented (typically the shorter distance to one of the mixer pumps defined the worst case) in Section 4.3. Where the forces from each pump were equally detrimental, both values were presented.

4.2.13 Fatigue and Cycling Analysis

Fatigue analysis was based on the approach contained in Winkel (1989). Bounding numbers of rotational cycles nozzle passes, were used with allowable stresses to calculate the maximum force that each component could endure without failing due to fatigue. Results of this analysis are presented in Section 4.3.

The yield stresses at the riser flange connections to the components were compared against AISC fatigue allowable values. The maximum force for each component to reach its allowable cycle limit is detailed in Appendix B.

From the data, it can be concluded that all components that fail due to fatigue are to be removed or controlled for other reasons. Therefore, no additional equipment needs to be removed due to this consideration.

4.3 Analysis Results

The following summarizes the results of calculations contained in Appendix B. Tables 4-1, 4-2, and 4-3 provide yield stress results. Table 4-4 summarizes deflection results, and Table 4-5 contains fatigue analysis results. Result analysis and recommendations by component are provided in section 4.1.3..

Table 4-1. Worst Case Summary of Estimated and Allowable Forces Tanks AW-101, -103,-104.

Component and Riser No.	Allowable Force (lbf) AISC	Estimated Force at 70% Pump Speed (lbf)		Estimated Force at 100% Pump Speed (lbf)		Distance from Center of Tank (ft)	Distance From Pump Nozzle (ft)	
		MP1	MP2	MP1	MP2		MP1	MP2
Temp Tree #5	366	40.7	42.1	80.3	88.7	3	22.5	16.5
Transfer Pump – 11" #12	1273	41.6	40.8	105.7	89.4	3	16.5	22.5
Transfer Pump – 32" #12	16,270	59.4	49.3	191.5	147.6	3	16.5	22.5

AISC value is .66Sy which has a safety factor applied for structural analysis.
Sy is ASME standard value for a material's yield stress.
Julyk value is based on the report analysis values that are higher than the AISC value and close to the standard Sy value

Table 4-2. Worst Case Summary of Estimated and Allowable Forces Tanks AY-101, 102.

Component and Riser No.	Allowable Force (lbf) AISC	Estimated Force at 70% Pump Speed (lbf)		Estimated Force at 100% Pump Speed (lbf)		Distance from Center of Tank (ft)	Distance From Closest Pump Nozzle (ft)	
		MP1	MP2	MP1	MP2		MP1	MP2
ALC-21 #2	603 Julyk	170	*	609	*	27	4.5	*
Thermowell – 21 Riser #3	154 (Sy)	49	*	99	*	27	4.5	*
ALC-14 Riser #2	603 Julyk	*	167	596		27	*	4.6
Thermowell – 14 Riser #3	154 (Sy)	*	48	96		27	*	4.6
Transfer Pump –11" Riser #6A	1273 AISC	40.8	40.8	89.8	89.8	6	22.3	22.3
Transfer Pump – 32" Riser #6A	16,270 AISC	49.5	49.5	148.7	148.7	6	22.3	22.3
Sluice Pit Drain Riser #10A	100 Sy	*	81	*	276	19	*	2.7
Leak Detection Pit Drain 1A from pump #2 Riser #11A	210 Sy	43.5	45.7	88.6	78.3		48.9	23.6
Drywell Riser #14A	269 Sy	47	41.4	78.7	103.5	12.5	329	12.3
New Temp. Tree with sludge Riser #15L	366 AISC	41.4	45	103.5	88	34.8	12.3	56.3
Tank Wall	4.7×10^6 AISC	247	247	913		37.5	15.5	15.5

AISC value is .66Sy which has a safety factor applied for structural analysis.
Sy is ASME standard value for a material's yield stress.
Julyk value is based on the report analysis values that are higher than the AISC value and close to the standard Sy value.
* Very close proximity to one mixer pump bounded this value.

Table 4-3. Worst Case Summary of Estimated and Allowable Forces Tanks SY-101, -102, -103.

Component Riser No. and Tank No.	Allowable Force (lbf) AISC	Estimated Force at 70% Pump Speed (lbf)		Estimated Force at 100% Pump Speed (lbf)		Distance from Center of Tank (ft)	Distance From Pump Nozzle (ft)	
		MP1	MP2	MP1	MP2		MP1	MP2
Vel Den Temp Tree Riser #3 – SY-101	61	47.8	41	84.1	104	20	38.1	9.9
New Temp Tree – all tanks Riser #5	366	40.8	42.9	88.7	803.	3	16.5	22.5
Transfer Pump 11" all tanks Riser #13	1273	40.8	41.6	89.4	105.7	3	22.5	16.5
Vel Den Temp Tree Riser #15 – SY-101	61	45.8	40.8	88.2	86.8	28	45.9	14.1
Multi-function Temp Tree SY-101, -103 Riser #18	42	48	48	81.8	81.8	28	33.9	33.9
Multi-function Temp Tree SY-101 Riser #19	42	41	44.9	86.8	88.2	28	14.1	45.9
Transfer Pump, SY-102 only Riser #23	106	45.4	41.3	87.6	102.5	30	49.1	11.1

AISC value is .66Sy which has a safety factor applied for structural analysis
Sy is ASME standard value for a material's yield stress
Julyk value is based on the report analysis values that are higher than the AISC value and close to the standard Sy value
* Very close proximity to one mixer pump bounded this value.

Table 4-4. Worst Case Analysis of Tank Components for Plastic Hinge Deflection.

TANK	RISER	EQUIPMENT	RADIUS TO CENTER OF TANK (ft)	YIELD STRESS CRITERIA (.66Sy or Sy)	DISTANCE TO MIXER PUMP (NOZZLE TO CL) (ft)	PLASTIC HINGE DEFLECTION (INCHES) MAX. ALLOWED	MAX. ESTIMATED AT 70% PUMP SPEED	MAX. ESTIMATED AT 100% PUMP SPEED
Same for all AW-101, 103, 104	5	New Temperature Tree - 6"	3	.66Sy	16.5	42.9	3.3	7
	12	New Transfer Pump - 11"	3	.66Sy	16.5	15.5	0.4	0.96
	12	New Transfer Pump - 32"	3	.66Sy	16.5	5.1	0.01	0.05
Samle for all AY-101, 102	2	ALC 101-21	27	Sy	4.5	2.3	0.5	1.8
	3	Thermowell attached to ALC	27	Sy	4.5	1.3	0.3	0.61
	6A	11" New Transfer Pump	22.3	.66Sy	21.5	15.5	0.37	0.82
	6A	32" New Transfer Pump	22.3	.66Sy	22.3	5	0.01	0.04
	10A	Sluice Pit Drain	19	Sy	2.7	99.4	4.8	16.2
	10C	Sluice Pit Drain	19	Sy	2.8	99.4	4.8	16.2
	11A	Leak Detection Pit Drain	32	.66Sy	23.9	32	7.2	14.3
	14A	Drywell - from pump #2	12.5	Sy	12.3	29.6	2.8	7
	14A	Drywell - from pump #1	12.5	Sy	33.4	45	3.2	5.3
	15L	New Temperature Tree from Pump #1	34.8	.66Sy	12.3	42.9	3.3	8.2
	15L	New Temperature Tree from Pump #2	34.8	.66Sy	56.3	42.9	3.6	7
SY-101	3	Vel Den Temp Tree from pump #2	20	.66Sy	9.9	60.8	32.9	81.7
SY-101	3	Vel Den Temp Tree from pump #1	20	.66Sy	9.9	60.8	32.9	81.7
Same for SY-101,102,103	5	New Temp tree from pump #1	3	.66Sy	16.5	42.9	3.2	7
Same for SY-101,102,103	5	New Temp tree from pump #2	3	.66Sy	22.5	42.9	3.4	6.4
Same for SY-101,102,103	13	Transfer Pump 11"	3	.66Sy	16.5	15.6	0.6	1.9
Same for SY-101,102,103	13	Transfer Pump 32"	3	.66Sy	16.5	5.1	0.4	1
SY-101	15	Vel Den Temp Tree from pump #2	28	.66Sy	14.1	67	32	68.2
SY-101	15	Vel Den Temp Tree from pump #1	28	.66Sy	45.9	67	36	69.3
SY-101,-103	18	MIT	28	.66Sy	33.9	67	58.3	98.4
SY-101 only	19	MIT from pump #1	28	.66Sy	14.1	67	49.8	107.6
SY-101 only	19	MIT from pump #2	28	.66Sy	45.9	67	54.5	105.8
SY-102 only	23	Supernate Feed Pump from pump #2	30	.66Sy	11.1	35.7	10.3	25.7
SY-102 only	23	Supernate Feed Pump from pump #1	30	.66Sy	49.1	35.7	11.4	21.9

With the estimated operating cycles provided by the Design Authority, and a fatigue force analysis from Winkle (1989), a prediction is made for fatigue failure. The results are presented in Table 4-5.

Table 4-5. Fatigue Analysis on Tank Components.

Tank & Components	Estimated Values		Allowable Force For Total Cycles	Maximum Calculated Force
AW-101, 103, 104 *	Duty Cycles per tank	Total Cycles	(lbf)	(lbf)
New Temperature Tree	10 @10 days each	57,600	225.4	88.7
Transfer Pump – 11"	10 @10 days each	57,600	857.2	105.7
Transfer Pump – 32"	10 @10 days each	57,600	10,939.5	191.5
AY-101, 102				
Air Lift Circulator 14 & 21	30 weeks	120,960	212.2	609
Transfer Pump – 11"	30 weeks	120,960	714.4	89.8
Transfer Pump – 32"	30 weeks	120,960	9116.3	148.7
Sluice Pit Drain	30 weeks	120,960	25.1	276
Drywell	30 weeks	120,960	99.4	103.5
New Temperature Tree	30 weeks	120,960	187.9	103.5
SY-101, 102				
VDTT riser #3	10 @10 days each	57,600	41.5	104
New Temperature Tree	10 @10 days each	57,600	225.4	88.7
New Transfer Pump – 11"	10 @10 days each	57,600	857.2	105.7
New Transfer Pump – 32"	10 @10 days each	57,600	10,939.5	191.5
VDTT riser #15	10 @10 days each	57,600	41.5	88.2
MIT riser #18	10 @10 days each	57,600	28.1	81.8
MIT riser #19	10 @10 days each	57,600	28.1	88.2
Transfer Pump – SY-102	10 @10 days each	57,600	71.4	102.5

Only the components that are closest to the mixer pumps, had the highest force, or which were marginal in acceptability are presented in the following tables. The rest of the values are in Appendix B along with the calculations.

It should be noted that the force values indicate an interesting anomaly. In some cases, the mixer pump furthest from an in-tank component imposes higher forces on the component than the closer pump. This phenomena is due to a sudden increase in the drag coefficient as a slowing flow transitions from turbulent to laminar conditions. With turbulent flow, the drag force decreases with decreasing flow velocity. Likewise, the drag force of a laminar flow decreases with decreasing flow velocity. However as a slowing flow transitions from turbulent to laminar, the drag increases as the flow field restructures itself around an object in the flow path (Fox 1985). This phenomena was not apparent in Julyk (2000) that considered lower viscosity wastes. Since the Reynolds number is inversely proportional to the fluid viscosity, lower viscosity fluids will transition from turbulent to laminar flow at a lower velocity. Thus, lower viscosity fluids will experience the force increase anomaly at a further distance from the mixer pump nozzle. Julyk used a viscosity of 2 cp that wouldn't produce the increased force anomaly until the jet flow was outside the tank shell. This analysis used a viscosity of 30 cp that results in increased drag coefficient in the 35 to 45 ft range.

4.3.1 Control Recommendations

241-AW Tank Component Recommendations

- The New Temperature Tree (riser 16, all tanks) is well within allowable forces for yield and deflection and is acceptable at 100 percent pump speed. Fatigue is not a concern on this component.

  Action: Pump may be operated at full speed when passing this device.

- The New Transfer Pump (riser 12, all tanks) is well within allowable forces and deflection at 100 percent pump speed. Fatigue is not a concern on this component.

  Action: Pump may be operated at full speed when passing this device.

241-AY Tanks

- The ALC-21 (riser 2, both tanks) slightly exceeds allowable force (6 lb f) due to yield at 100 percent pump speed; it is within 12 percent of allowable with respect to deflection. Fatigue is a primary concern at 100 percent pump speed, especially during pump insertion. At 70 percent pump speed; the force values are well below allowable forces.

  Action: Slow pump speed to less than 100 percent (i.e. 70 percent) when passing this device. This action is only necessary when operating the mixer pump during incremental lowering. Pump may be run at 100 percent when fully inserted. Detailed fatigue analysis should be performed in Definitive Design.

- The ALC-14 (riser 2, both tanks) falls within 5 percent of allowable force at 100 percent pump speed. This is beyond the margin of error for this calculation.

  Action: Slow pump speed to less than 100 percent (i.e. 70 percent) when passing this device. This action is only necessary when operating the mixer pump during incremental lowering. Detailed fatigue analysis should be performed in Definitive Design.

- The ALC-21 Thermowell (riser 3, both tanks) does not exceed allowable force or allowable deflection at 100 percent pump speed.

Action: Pump may be operated at full speed when passing this device.

- The ALC-14 Thermowell (riser 3, both tanks) does not exceed allowable force or allowable deflection at 100 percent pump speed.

  Action: Pump may be operated at full speed when passing this device.

- The Sluice Pit Drain (risers 10C and 10A, both tanks) exceeds allowable force due to yield and deflection at 100 percent pump speed. Fatigue is a concern at 100 percent pump speed, especially during pump insertion. At 70 percent pump speed, force values are below allowable forces for yield and deflection.

  Action: Operate pump below 70 percent speed when passing this device. The drain only extends to within 5 ft of the tank bottom; therefore, reduced speed may only be necessary during incremental pump insertion. Detailed fatigue analysis should be performed during Definitive Design.

- The Drywell (riser 14B, both tanks) does not exceed allowable force or allowable deflection at 100 percent pump speed, however, the components are above allowable for fatigue.

  Action: Operate pump below 100 percent speed when passing this device. Detailed fatigue analysis should be performed during Definitive Design.

- The Leak Detection Pit Drain (riser 11A, both tanks) does not exceed allowable force or allowable deflection at 100 percent pump speed. Fatigue is not a concern for this component.

  Action: Pump may be operated at full speed when passing this device.

- The New Temperature Tree (risers 15D and 15L, both tanks) does not exceed allowable force or deflection at 100 percent pump speed. Fatigue is not a concern for this component.

  Action: Pump may be operated at full speed when passing this device.

- The Tank Wall forces are well below allowable.

  Action: Pump may be operated at full speed when passing the tank wall.

241-SY Tanks

- The Velocity Density Temperature Tree (riser 3, tank 101) exceeds the allowable force and allowable deflection at 100 percent speed. Fatigue is also a concern.

Action: This instrument should be removed from the tank since it is not needed from an operational or safety perspective. Slowing the mixer pump speed would reduce mixing effectiveness without a noticeable benefit.

- The Velocity Density Temperature Tree (riser 15, tank 101) exceeds the allowable force and allowable deflection at 100 percent speed. Fatigue is also a concern.

  Action: This instrument should be removed from the tank since it is not needed from an operational or safety perspective. Slowing the mixer pump speed would reduce mixing effectiveness without a noticeable benefit.

- The Multi-Function Instrument Tree (riser 18, tanks 101 and 103) exceeds allowable force and deflection at 100 percent and exceeds allowable force at 70 percent speed. Fatigue is also a concern.

  Action: This instrument should be removed from the tank since it is not needed from an operational or safety perspective. Slowing the mixer pump speed would reduce mixing effectiveness without a noticeable benefit.

- The Multi-Function Instrument Tree (riser 19, tank 101) exceeds allowable force and deflection at 100 percent and exceeds allowable force at 70 percent speed. Fatigue is also a concern.

  Action: This instrument should be removed from the tank since it is not needed from an operational or safety perspective. Slowing the mixer pump speed would reduce mixing effectiveness without a noticeable benefit. Fatigue is also a concern.

- The Transfer Pump (riser 023, tank 102) is within 5 percent of allowable force at 100 percent pump speed. This is within the margin of error for the calculation. It does not exceed allowable deflection.

  Action: This pump should be removed from the tank since it is not needed from an operational or safety perspective. Slowing the mixer pump speed would reduce mixing effectiveness without a noticeable benefit.

- The New Transfer Pump (riser 013, all tanks) is well within allowable forces and deflection at 100 percent pump speed. Fatigue is not a concern.

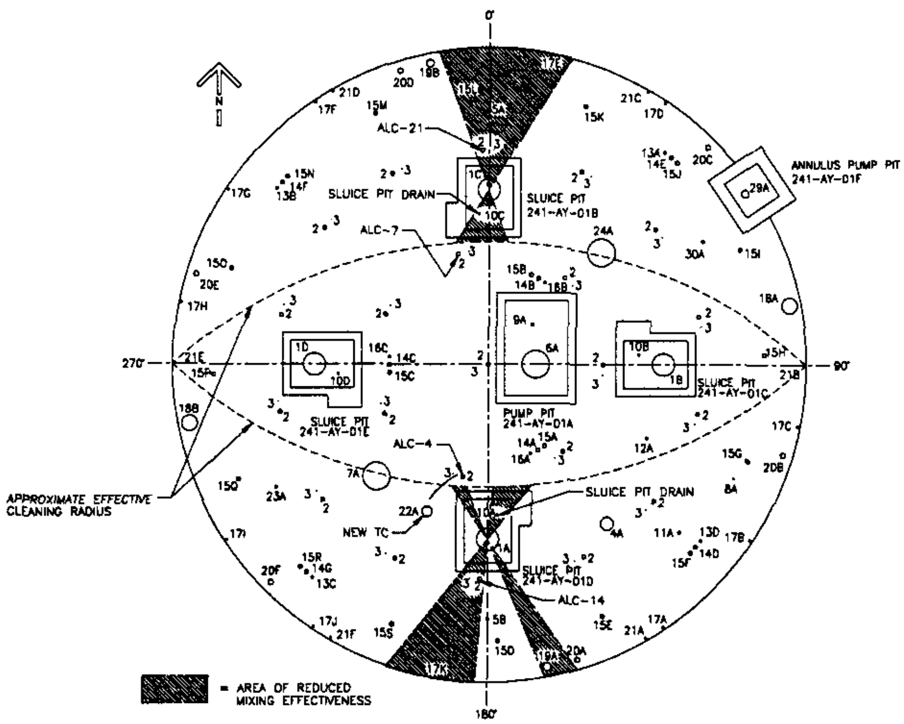
  Action: Pump may be operated at full speed when passing this device.

- The New Temperature Tree (riser 005, all tanks) is well within allowable forces and deflection at 100 percent pump speed. Fatigue is not a concern.

  Action: Pump may be operated at full speed when passing this device.

4.3.2 Effect of Reduced Pump Speed on Tank Mixing

Reduction of pump speed, as is recommended to preclude damage to some components, imposes areas of reduced mixing effectiveness. When this is taken in conjunction with the overlap from another pump, there is a resulting shadow effect (refer to Figures 4-11 and 4-12.)



PLAN VIEW TANK 241-AY-101

Figure 4-11. Plan View Tank 241-AY-101.

While this effort can have slight impacts on the overall mixing of the tank wastes, operation of the mixer pumps in the recommended manner should not significantly impact waste characteristics. This result appears to be confirmed based on the test results from mixer pump operation in tank AZ-101.

Further analysis must continue as more detailed data becomes available from pump manufacturers, field tests, and waste sampling.

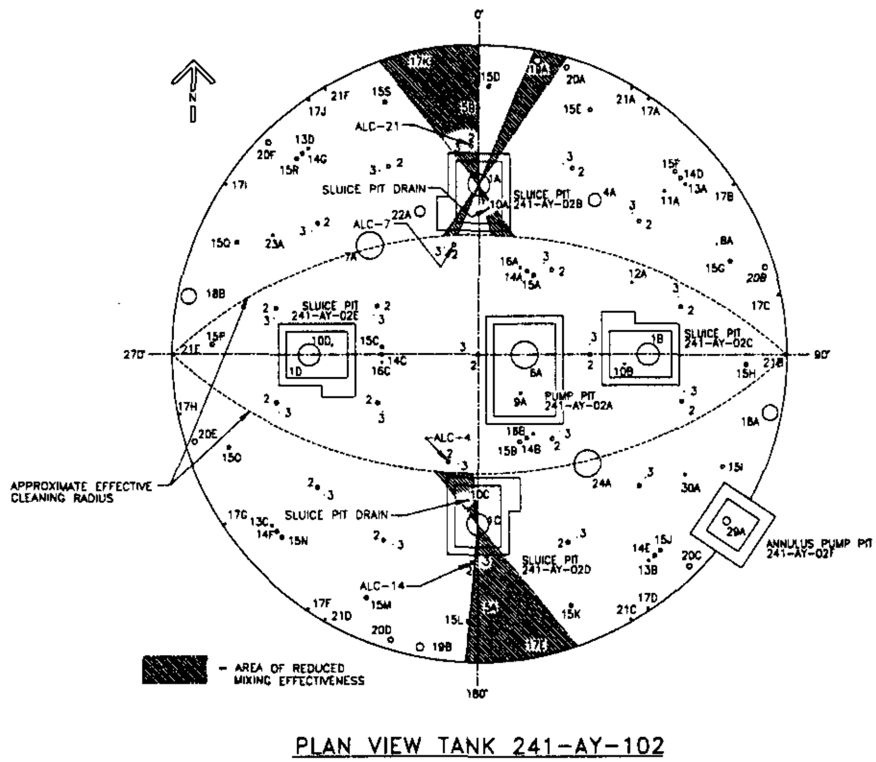


Figure 4-12. Plan View Tank 241-AY-102.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Tables 4-1 through 4-3 summarize the results of the impingement force analysis performed on key components installed in tanks AW-101, -03, -04, AY-101, -102, SY-101, -02, and -03 at 100 percent and 70 percent mixer pump speeds. Plastic hinge deflections, and allowable deflections based on component shape, associated with those maximum forces are calculated in Appendix B and tabulated in Tables 4-4 and 4-5. The results also consider fatigue analysis.

Overall conclusions and recommendations are provided in the following sections.

5.1 241-AW Farm

All components within the AW tanks can withstand the impingement forces that will be applied. Since transfer pump design is not yet determined, the procurement specification should make it clear the forces that these pumps must endure while operating.

5.2 241-AY Farm

The ALCs closest to the mixer pumps (ALC-21 and ALC-14) will experience forces slightly exceeding or very near their allowable if the mixer pump is operated while it is being lowered into its final installed position. In addition, forces calculated exceed the allowable for fatigue. Thus, the mixer pump speed should be slowed while a jet nozzle is passing these components. After full insertion of the pump, the jet flow will mostly pass under the ALCs; at this time , it should be possible to operate pumps at 100 percent speed. Further analysis is needed.

The ALC thermowells do not have an operational use, are permanently welded in place, and analysis demonstrates they will not exceed their limit load for yield or deflection. No controls are recommended for these components.

The sluice pit drains exceed their yield force allowable limit for 100 percent pump speed. In addition, forces calculated exceed that allowed for fatigue. Mixer pumps will only impinge on these components as they are being lowered into the tanks. Therefore, when the pump jets are in-line with any of the ALC thermowells and sluice pit drains they should be at 70 percent speed. If operated for the entire project mission with jets in line with the drains (an unlikely occurrence) fatigue is an area of concern for these components. This should be further analyzed during Definitive Design.

The previous discussion identified certain components that require a reduction in mixer pump operating speeds as the nozzles oscillate past in order to avoid damage to the components. This reduction in speed will create certain areas in the tank where the mixing effectiveness will be slightly diminished.

5.3 SY Farm

Fatigue concerns associated with the velocity density temperature trees in tank SY-101 make it advisable to remove these components. Replacement is not required as the temperature measurement function is being met by the new temperature tree to be installed in riser 5.

Fatigue concerns associated with the multi-function instrument trees in tank SY-101 and SY-103 make it advisable to remove these components. Replacement is not required as the temperature measurement function is being met by the new temperature tree to be installed in Riser 5. However, tank pressure measurement will be needed on each tank and a tie-in for the existing gas sample station will be needed.

The existing inoperable evaporator transfer feed pump installed in riser 23 of tank SY-102 should be removed since it will affect the effectiveness of tank mixing, is not needed, exceeds fatigue allowed, and is near its allowable force value.

5.4 General Recommendations

In all tanks there are two mixer pumps operating simultaneously. Coincidental jet forces impinging on components simultaneously will produce a larger, cumulative force than that which has been calculated in this report. Therefore, controls should be placed on the pumps such that jets will not contact a vulnerable component simultaneously.

During design, after mixer pumps have been specified more thoroughly and increased pump performance data is known, this analysis should be reviewed to verify or modify conclusions.

During mixing operations, it is recommended that cameras be used to verify and periodically monitor deflection of installed components due to mixer pump forces.

5.5 Cost Impact

No cost savings from the CDR baseline estimate results from this detailed analysis. The cost increase due to removing additional components have been accounted for in Task 12 (see Attachment L).

6.0 REFERENCES

AISC 1989, *Manual of Steel Construction – Allowable Stress Design,* American Institute of Steel Construction, Inc. Chicago, Illinois.

Bambeger, J.A., J.M. Bates, and E. D. Waters, 1990, *Final Report: Experimental Characterization of Jet Static Forces Impacting Waste Tank Components,* PNL-7394, Pacific Northwest Laboratory, Richland, Washington.

Carlson, AB. 2000, *Preliminary Test Report, 241-AZ-101 Mixer Pump Test*, RPP-6548, Rev. 0, CH2M Hill Hanford Group, Richland, Washington.

Fargo, S.A., and K.C. Tu, 1999, *Waste Feed Delivery Program Lateral Forces on Transfer Pumps, Thermocouple Trees, and Impingement Forces on Tank Walls Imparted by Mixer Pumps,* Flour Daniel Northwest, Richland, WA.

Julyk, L.J., 1997, *Evaluation of the Effect of Project W-151 Mixer Pump Jets on In-Tank Equipment Considering Potential Sludge Buildup on Equipment in Waste Tank 241-AZ-101, Hanford Site, Richland, Washington,* HNF-SD-W151-DA-008, Fluor Daniel Northwest, Richland, Washington.

Shaw, C.P., 2000, *Double-Shell Tank Mixer Pump Subsystem Specification*, HNF-4164, Rev. 0, COGEMA Engineering Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

Trent, D.S. and Mahoney, L.A., 1994, *Simplified Procedure for Estimation Cross-Stream Jet Forces on Waste Tank Instrument Trees,* PNL MIT 030194, Pacific Northwest Laboratory, Richland, Washington.

Wood, R.F. and Tucker R.P., 2000, *Completion of TPP FY/2000 PI ORP 4.2.1 Rev. 1 AZ101 Process Test Section 3 Stretch 4 and Section 4 Define Completion,* CHG-0002835, CH2M HILL Hanford Group, Richland, Washington.

Appendix A
Spreadsheets and Diagrams for Tank Component Locations

Tank: AW-101

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	270	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	85	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

	Riser No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Distance from nozzle to object edge Mixer #1 (ft)	Distance from nozzle to object edge Mixer #2 (ft)	Equipment removed by W-521	Drawing
	1	4	Manual Tape	180	20.0	N								
	2	4	Sludge Measurement	300	20.0	N								
	3	4	Sludge Measurement	60	20.0	N								
	4	4	Enraf	20	20.0	N								
R&I *	5	12	(New) Temperature Tree	90	3.0	Y	6		23.0	17.0	22.3	16.3	Transfer Pump	H-2-91943 (6)
R/NR	6	4	Spare	140	20.0	Y	4	(4)	36.3	18.5	35.6	17.8	Thermocouple Probe	H-14-020000
I	7	42	(New) Mixer Pump	270	20.0	Y	42	(2)	n/a	40.0	n/a	37.7	Shield Plug	
R&I	8	42	(New) Mixer Pump	85	20.0	Y	42	(2)	40.0	n/a	37.7	n/a	Camera/Instruments	H-2-821102
	9	12	Vent Exhaust	240	20.0	N								
	10	12	Vent Inlet	120	20.0	N								
	11	4	Spare	220	28.0	N								
R&I *	12	42	(New) Transfer Pump	270	3.0	Y	42	(3)	17.0	23.0	14.8	20.7	Slurry Distributor	H-14-020000
I	13	12	New Camera	270	9.0	N								
	14	4	Sludge Measurement	190	28.0	N								
	15	4	Tank Pressure	145	28.0	N								
	16	4	Drop Leg - Pressure Relief	90	6.0	N								
R/NR	17	4	Spare	300	28.0	Y	4	(4)	14.6	45.8	14.0	45.2	Multi-Function Instrument Tree	H-14-020000
	18	4	Sludge Measurement	240	28.0	N								
	19	4	Tank Pressure	0	28.0	N								
	20	4	Sludge Measurement	120	28.0	N								
	21	4	High Level Sensor	330	20.0	N								
	22	4	Sludge Measurement	0	10.0	N								
	23	12	Spare	280	30.0	N								
	24	12	Spare	70	30.0	N								
	25	20	Spare	180	33.0	N								
	26	20	Spare	0	33.0	N								
	27	36	Spare	348.6	33.7	N								
	Wall	n/a	Closest Primary Tank Wall	n/a	37.5	Y	n/a		17.5	17.5	17.0	17.0		

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
(6) Per WHC-SD-WM-RPT-025, Rev. 1
I Indicates W-521 equipment installed in an empty riser
R Indicates equipment must be removed from riser before W-521 equipment can be installed
R/NR Indicates existing equipment is to be removed and not replaced with new equipment
* Indicates that this component has been analyzed for yield stress and deflection

9/29/00

Tank: AW-103

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	270	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	85	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

	Riser No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Distance from nozzle to object edge Mixer #1 (ft)	Distance from nozzle to object edge Mixer #2 (ft)	Equipment removed by W-521	Drawing
	1	4	Manual Tape	180	20.0	N								
	2	4	Sludge Measurement	300	20.0	N								
	3	4	Sludge Measurement	60	20.0	N								
	4	4	Enraf	20	20.0	N								
R&I *	5	12	(New) Temp Tree	90	3.0	Y	6		23.0	17.0	22.3	16.3	Transfer Pump	H-2-91943 (6)
R/NR	6	4	Spare	140	20.0	Y	4	(4)	36.3	18.5	35.6	17.8	Thermocouple Probe	H-14-020000
I	7	42	(New) Mixer Pump	270	20.0	Y	42	(2)	n/a	40.0	n/a	37.7	Shield Plug	
I	8	42	(New) Mixer Pump	85	20.0	Y	42	(2)	40.0	n/a	37.7	n/a	Shield Plug	
	9	12	Vent Inlet	240	20.0	N								
	10	12	Vent Exhaust	120	20.0	N								
	11	4	Multi-Purpose Probe	220	28.0	N								
R&I *	12	42	(New) Transfer Pump/Drop Leg	270	3.0	Y	42	(3)	17.0	23.0	14.8	20.7	Slurry Distributor	H-14-020000
I	13	12	New Camera	270	9.0	N								
R/NR	14	4	Spare	190	28.0	Y	4	(4)	31.5	38.4	30.8	37.7	Liquid Observation Well	H-14-020000
	15	4	Tank Pressure	145	28.0	N								
	16	4	Drop Leg - Pressure Relief	90	6.0	N								
	17	4	Spare	300	28.0	N								
	18	4	Sludge Measurement	240	28.0	N								
	19	4	Tank Pressure	0	28.0	N								
	20	4	Sludge Measurement	120	28.0	N								
	21	4	High Level Sensor	330	20.0	N								
	22	4	Sludge Measurement	0	10.0	N								
	Wall	n/a	Closest Primary Tank Wall	n/a	37.5	Y	n/a		17.5	17.5	17.0	17.0		

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
(6) Per WHC-SD-WM-RPT-025, Rev. 1
I Indicates W-521 equipment installed in an empty riser
R Indicates equipment must be removed from riser before W-521 equipment can be installed
R/NR Indicates existing equipment is to be removed and not replaced with new equipment
* Indicates that this component has been analyzed for yield stress and deflection

9/29/00

Tank: AW-104

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	270	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	85	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

	Riser No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Distance from nozzle to object edge Mixer #1 (ft)	Distance from nozzle to object edge Mixer #2 (ft)	Equipment removed by W-521	Drawing
	1	4	Manual Tape	180	20.0	N								
	2	4	Sludge Measurement	300	20.0	N								
	3	4	Sludge Measurement	80	20.0	N								
	4	4	Enraf	20	20.0	N								
R&I *	5	12	(New) Temp Tree	90	3.0	Y	6		23.0	17.0	22.3	16.3	Transfer Pump	H-2-91943
R/NR	6	4	Spare	140	20.0	Y	4		36.3	18.5	35.6	17.8	Thermocouple Tree	H-14-020000
I	7	42	(New) Mixer Pump	270	20.0	Y	42	(2)	n/a	40.0	n/a	37.7	Shield Plug	
I	8	42	(New) Mixer Pump	85	20.0	Y	42	(2)	40.0	n/a	37.7	n/a	Shield Plug	
	9	12	Vent Exhaust	240	20.0	N								
	10	12	Vent Inlet	120	20.0	N								
	11	4	Multi-Purpose Probe	220	28.0	N								
R&I *	12	42	(New) Transfer Pump/Drop Leg	270	3.0	Y	42	(3)	17.0	23.0	14.8	20.7	Slurry Distributor	H-14-020000
I	13	12	New Camera	270	9.0	N								
	14	4	Sludge Measurement	190	28.0	N								
	15	4	Tank Pressure	145	28.0	N								
	16	4	Drop Leg - Pressure Relief	90	6.0	N								
	17	4	Spare	300	28.0	N								
	18	4	Sludge Measurement	240	28.0	N								
	19	4	Tank Pressure	0	28.0	N								
	20	4	Sludge Measurement	120	28.0	N								
	21	4	High Level Sensor	330	20.0	N								
R/NR	22	4	Spare	0	10.0	Y	4	(4)	22.4	21.6	21.7	20.9	Liquid Observation Well	H-14-020000
	Wall	n/a	Closest Primary Tank Wall	n/a	37.5	Y	n/a		17.5	17.5	17.0	17.0		

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) *Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser*
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
(6) Per WHC-SD-WM-RPT-025, Rev. 1
I Indicates W-521 equipment installed in an empty riser
R Indicates equipment must be removed from riser before W-521 equipment can be installed
R/NR Indicates existing equipment is to be removed and not replaced with new equipment
* Indicates that the component has been analyzed for yield stress and deflection

k: AY-101

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 01B (new mixer pump)	0	22.0
Mixer Pump #2 in Riser 01C (new mixer pump)	90	22.0
Mixer Pump #3 in Riser 01D (new mixer pump)	180	22.0
Mixer Pump #4 in Riser 01E (new mixer pump)	270	22.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

	Riser No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #3 (ft)	Distance from Nozzle to object edge Mixer #1 (ft)	Distance from Nozzle to object edge Mixer #3 (ft)	Equipment removed by W-521	Drawing
R&I	1A	34	(New) Mixer Pump - 01D	180.0	22.0	Y	34	(2)	44.0	0.0	42.1	-1.9	Transfer Pump	H-2-65054 (7)
	1B	34	Spare	90.0	22.0	N	34							
R&I	1C	34	(New) Mixer PumP - 01B	0.0	22.0	Y	34	(2)	0.0	44.0	-1.9	42.1	Transfer Pump	(8)
	1D	34	Spare	270.0	22.0	N	34							
	2	6	Air Lift Circulator 101-1	0.0	0.0	Y	30	(6)	22.0	22.0	20.3	20.3		H-2-64419
	3	0.75	Thermocouple for ALC 101-1	270.0	1.3	Y	0.75		22.0	22.0	21.5	21.5		
	2	6	Air Lift Circulator 101-2	90.0	14.5	Y	30	(6)	26.3	26.3	24.6	24.6		H-2-64419
	3	0.75	Thermocouple for ALC 101-2	95.2	14.5	Y	0.75		27.4	25.2	26.9	24.7		
	2	6	Air Lift Circulator 101-3	139.4	14.5	Y	30	(6)	34.3	14.5	32.6	12.7		H-2-64419
	3	0.75	Thermocouple for ALC 101-3	144.6	14.5	Y	0.75		34.8	13.2	34.3	12.7		
	2	6	Air Lift Circulator 101-4	192.9	14.5	Y	30	(6)	36.3	8.5	34.5	6.8		H-2-64419
	3	0.75	Thermocouple for ALC 101-4	198.1	14.5	Y	0.75		36.1	9.4	35.5	8.0		
	2	6	Air Lift Circulator 101-5	244.4	14.5	Y	30	(6)	31.1	20.5	29.4	18.7		H-2-64419
	3	0.75	Thermocouple for ALC 101-5	249.6	14.5	Y	0.75		30.3	21.7	29.7	21.2		
	2	6	Air Lift Circulator 101-6	295.7	14.5	Y	30	(6)	20.4	31.2	18.7	29.4		H-2-64419
	3	0.75	Thermocouple for ALC 101-6	300.9	14.5	Y	0.75		19.1	32.0	18.6	31.4		
	2	6	Air Lift Circulator 101-7	344.4	14.5	Y	30	(6)	8.9	36.2	7.2	34.4		H-2-64419
	3	0.75	Thermocouple for ALC 101-7	349.5	14.5	Y	0.75		8.2	36.4	8.4	35.8		
	2	6	Air Lift Circulator 101-8	41.4	14.5	Y	30	(6)	14.7	34.3	12.9	32.5		H-2-64419
	3	0.75	Thermocouple for ALC 101-8	46.6	14.5	Y	0.75		16.0	33.7	15.5	33.1		
	2	6	Air Lift Circulator 101-9	50.9	27.0	Y	30	(6)	21.5	44.3	19.8	42.6		H-2-64419
	3	0.75	Thermocouple for ALC 101-9	53.6	27.0	Y	0.75		22.5	43.8	22.0	43.3		
	2	6	Air Lift Circulator 101-10	77.2	27.0	Y	30	(6)	30.8	38.4	29.1	36.7		H-2-64419
	3	0.75	Thermocouple for ALC 101-10	79.9	27.0	Y	0.75		31.7	37.7	31.2	37.2		
	2	6	Air Lift Circulator 101-11	103.4	27.0	Y	30	(6)	38.6	30.6	36.8	28.9		H-2-64419
	3	0.75	Thermocouple for ALC 101-11	106.2	27.0	Y	0.76		39.3	29.7	38.8	29.2		
	2	6	Air Lift Circulator 101-12	129.6	27.0	Y	30	(6)	44.4	21.4	42.6	19.6		H-2-64419
	3	0.75	Thermocouple for ALC 101-12	132.5	27.0	Y	0.75		44.9	20.3	44.4	19.7		
	2	6	Air Lift Circulator 101-13	153.1	27.0	Y	30	(6)	47.7	12.4	45.9	10.6		H-2-64419
	3	0.75	Thermocouple for ALC 101-13	156.0	27.0	Y	0.75		47.9	11.3	47.4	10.8		
	2	6	Air Lift Circulator 101-14	182.1	27.0	Y	30	(6)	49.0	5.1	47.2	3.3		H-2-64419
	3	0.75	Thermocouple for ALC 101-14	184.9	27.0	Y	0.75		49.0	5.4	48.4	4.6		
	2	6	Air Lift Circulator 101-15	205.7	27.0	Y	30	(6)	47.8	11.9	46.0	10.2		H-2-64419
	3	0.76	Thermocouple for ALC 101-15	208.5	27.0	Y	0.75		47.5	13.0	47.0	12.5		
	2	6	Air Lift Circulator 101-16	230.9	27.0	Y	30	(6)	44.3	21.5	42.6	19.8		H-2-64419
	3	0.75	Thermocouple for ALC 101-16	233.6	27.0	Y	0.75		43.8	22.5	43.3	22.0		
	2	6	Air Lift Circulator 101-17	257.2	27.0	Y	30	(6)	38.4	30.8	36.7	29.1		H-2-64419
	3	0.76	Thermocouple for ALC 101-17	259.6	27.0	Y	0.75		37.8	31.6	37.3	31.1		
	2	6	Air Lift Circulator 101-18	283.4	27.0	Y	30	(6)	30.6	38.6	28.9	36.8		H-2-64419
	3	0.75	Thermocouple for ALC 101-18	286.1	27.0	Y	0.75		29.7	39.3	29.2	38.7		
	2	6	Air Lift Circulator 101-19	309.6	27.0	Y	30	(6)	21.4	44.4	19.6	42.6		H-2-64419
	3	0.75	Thermocouple for ALC 101-19	312.4	27.0	Y	0.75		20.3	44.9	19.8	44.3		
	2	6	Air Lift Circulator 101-20	333.1	27.0	Y	30	(6)	12.4	47.7	10.6	45.9		H-2-64419
	3	0.75	Thermocouple for ALC 101-20	335.9	27.0	Y	0.75		11.3	47.9	10.8	47.4		
	2	6	Air Lift Circulator 101-21	358.4	27.0	Y	30	(6)	5.0	49.0	3.3	47.2		H-2-64419
	3	0.75	Thermocouple for ALC 101-21	1.1	27.0	Y	0.75		5.0	49.0	4.5	48.5		
	2	6	Air Lift Circulator 101-22	25.7	27.0	Y	30	(6)	11.9	47.8	10.2	46.0		H-2-64419

9/29/00

	r No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Waste (Y/N)	Diam (in)	Note	er #1 (ft)	Mixer #3 (ft)	Mixer #1 (ft)	Mixer #3 (ft)	Equipment removed by W-521	Drawing
	3	0.75	Thermocouple for ALC-101-22	28.5	27.0	Y	0.75		13.0	47.5	12.5	47.0		
	4A	20	Vent Exhaust (old)	143.0	25.0	N								
/	5A	4	Level Indicator (ENRAF)	0.0	32.0	N								H-2-817634
	5B	4	Tank Pressure	180.0	32.0	N								
R&I •	6A	42	(New) Transfer Pump/Drop Leg	90	6.0	Y	10	(5)	22.8	22.8	21.9	21.9	Slurry Distributor	(9)
	7A	42	Steam Coil	225.0	20.0	Y	42		38.8	16.2	36.6	13.9		H-2-34669
	8A	2	Condensate Addition	116.0	34.0	N								
	9A	4	Pump Pit Drain 1A	47.7	7.4	Y	4		17.9	27.6	17.2	26.9		H-2-64313 H-2-64419
•	10A	3	Sluice Pit Drain 01D	176.3	19.0	Y	3		41.0	3.3	40.4	2.7		H-2-64614
•	10B	3	Sluice Pit Drain 01C	86.3	19.0	Y	3		28.1	30.0	27.5	29.4		H-2-64614
•	10C	3	Sluice Pit Drain 01B	356.3	19.0	Y	3		3.3	41.0	2.7	40.4		H-2-64614
•	10D	3	Sluice Pit Drain 01E	266.3	19.0	Y	3		30.0	28.1	29.4	27.5		H-2-64614
•	11A	4	Leak Detection Pit Drain	131.3	32.0	Y	4		49.4	24.1	48.7	23.4		H-2-64405
	12A	4	High Level Indicator	115.0	22.0	N								
R/NR	13A	4	Spare	38.1	34.8	Y	4		22.1	53.8	21.4	53.1	Profile Thermocouple Probe	H-2-64368
R/NR	13B	4	Spare	128.1	34.8	Y	4		51.3	27.4	50.7	26.7	Profile Thermocouple Probe	H-2-64368
R/NR	13C	4	Spare	218.1	34.8	Y	4		53.8	22.1	53.1	21.4	Profile Thermocouple Probe	H-2-64368
R/NR	13D	4	Spare	308.1	34.8	Y	4		27.4	51.3	26.7	50.7	Profile Thermocouple Probe	H-2-64368
	14A	6	Dry Well	160	12.5	Y	6		33.4	12.8	32.7	12.1		H-2-64419 H-2-64448
•	14B	6	Dry Well	30	12.5	Y	6		12.0	33.4	12.1	32.7		H-2-64419 H-2-64448
	14C	6	Dry Well	270	12.5	Y	6		25.3	25.3	24.6	24.6		H-2-64419 H-2-64448
	14D	6	Dry Well	129.7	34.8	Y	6		51.6	26.8	50.9	26.0		H-2-64419 H-2-64448
	14E	6	Dry Well	39.7	34.8	Y	6		22.7	53.6	21.9	52.8		H-2-64419 H-2-64448
	14F	6	Dry Well	309.7	34.8	Y	6		26.8	51.6	26.0	50.9		H-2-64419 H-2-64448
	14G	6	Dry Well	219.7	34.8	Y	6		53.6	22.7	52.8	21.9		H-2-64419 H-2-64448
/	15A	6	New Temperature Tree	145.4	12.5	N	6							
	15B	6	Sludge Measurement	25.4	12.5	N	6							
	15C	6	SHMS Vapor Probe	265.4	12.5	N	6							
/	15D	6	(New) Temperature Tree	176.3	34.8	Y			56.8	12.9	56.3	12.4		
	15E	6	Sludge Measurement	153.8	39.7	N								
	15F	6	Sludge Measurement	131.3	34.8	N	6							
	15G	6	Spare	108.8	39.7	N								
/	15H	6	(New) Temperature Tree	87.9	34.8	Y			40.5	41.8	40.0	41.3		
	15I	6	Spare	65.4	39.7	N								
	15J	6	Sludge Level	41.3	34.8	N								
	15K	6	Sludge Measurement	18.8	39.7	N								
	15L	6	(New) Temperature Tree	357.9	34.8	Y	6.5/2.6		12.8	56.8	12.3	56.3		
	15M	6	Spare	335.4	39.7	N								
	15N	6	Sludge Measurement	311.3	34.8	N	6							
	15O	6	Sludge Measurement	288.8	39.7	N								
/	15P	6	(New) Temperature Tree	267.9	34.8	Y			41.8	40.5	41.3	40.0		
	15Q	6	Spare	245.4	39.7	N								
	15R	6	Vent Inlet	221.3	34.8	N								
	15S	6	Sludge Level/Tank Press.	198.8	39.7	N								
R/NR	16A	4	Spare	154.6	12.5	Y	4	(4)	33.7	12.0	33.1	11.3	Sludge Temperature	H-2-64368
R/NR	16B	4	Spare	34.6	12.5	Y	4	(4)	13.7	33.1	13.0	32.4	Sludge Temperature	H-2-64368
R/NR	16C	4	Spare	274.6	12.5	Y	4	(4)	24.4	26.2	23.7	25.6	Sludge Temperature	H-2-64368
R&I	22A	16	New Camera	202.5	20.0	Y			41.2	8.4	40.7	7.9	Level Ind. (Enraf)	H-2-817634
	23A	4	Level Indicator	240.0	31.0	N								
	24A	42	Vent Return	45.0	20.0	N								
	30A	4	Annulus Pump Discharge	60.0	31.0	Y	4		27.6	46.1	27.0	45.6		H-2-63796
	Wall	n/a	Closest Primary Tank Wall	n/a	37.5	Y	n/a		15.5	15.5	15.0	15.0		

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
(6) Air lift circulators have inner pipe diameters of 6 inches (consistent with riser) and outer diameters of 30 inches
(7) Per WHC-SD-WM-RPT-025, Rev. 1
(8) HNF-3218, Rev. 0 indicates this pump was removed from the tank on 8/22/83

9/29/00

r No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Waste (Y/N)	Diam (in)	Note	r #1 (ft)	Mixer #3 (ft)	Mixer #1 (ft)	Mixer #3 (ft)	Equipment removed by W-521	Drawing

(9) Per ESW-521-M1, SHT 1 (no other source document shows a pump is installed in this riser)

I Indicates W-521 equipment installed in an empty riser

R Indicates equipment must be removed from riser before W-521 equipment can be installed

R/NR Indicates existing equipment is to be removed and not replaced with new equipment

* Indicates that this component has been analyzed for yield stress and deflectio

k: AY-102

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 01A (new mixer pump)	0	22.0
Mixer Pump #2 in Riser 01B (new mixer pump)	90	22.0
Mixer Pump #3 in Riser 01C (new mixer pump)	180	22.0
Mixer Pump #4 in Riser 01D (new mixer pump)	270	22.0

Distance from pump CL to edge of nozzle (ft) 0.5 ee note 1)

	Riser No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) ixer # (ft)	Distance (CL-CL) Mixer #3 (ft)	istance from Nozzle to object edge Mixer # (ft)	istance from Nozzle to object edge Mixer #3 (ft)	Equipment removed by W-521	Drawing
R&I	1A	34	(New) Mixer Pump - 02B	0.0	22.0	Y	34	(2)	0.0	44.0	-1.9	42.1	Mixer Pump	H-2-95343 (7)
	1B	34	Spare	90.0	22.0	N	34							
R&I	1C	34	(New) Mixer Pump - 02D	180.0	22.0	Y	34	(2)	44.0	0.0	42.1	-1.9	Transfer Pump	H-2-93179 (7)
	1D	34	Spare	270.0	22.0	N	34							
	2	6	Air Lift Circulator 102-1	0.0	0.0	Y	30	(6)	22.0	22.0	20.3	20.3		H-2-64419
	3	0.75	Thermocouple for ALC 102-1	270.0	1.3	Y	0.75		22.0	22.0	21.5	21.5		H-2-64419
	2	6	Air Lift Circulator 102-2	90.0	14.5	Y	30	(6)	26.3	26.3	24.6	24.6		H-2-64419
	3	0.75	Thermocouple for ALC 102-2	84.8	14.5	Y	0.75		25.2	27.4	24.7	26.9		H-2-64419
	2	6	Air Lift Circulator 102-3	138.6	14.5	Y	30	(6)	34.2	14.7	32.5	12.9		H-2-64419
	3	0.75	Thermocouple for ALC 102-3	133.4	14.5	Y	0.75		33.7	16.0	33.1	15.5		H-2-64419
	2	6	Air Lift Circulator 102-4	195.7	14.5	Y	30	(6)	36.2	8.9	34.4	7.2		H-2-64419
	3	0.75	Thermocouple for ALC 102-4	190.5	14.5	Y	0.75		36.4	8.2	35.8	8.4		H-2-64419
	2	6	Air Lift Circulator 102-5	244.3	14.5	Y	30	(6)	31.2	20.4	29.4	18.7		H-2-64419
	3	0.75	Thermocouple for ALC 102-5	239.1	14.5	Y	0.75		32.0	19.1	31.4	18.6		H-2-64419
	2	6	Air Lift Circulator 102-6	295.6	14.5	Y	30	(6)	20.5	31.1	18.7	29.4		H-2-64419
	3	0.75	Thermocouple for ALC 102-6	290.4	14.5	Y	0.75		21.7	30.3	21.2	29.7		H-2-64419
	2	6	Air Lift Circulator 102-7	347.1	14.5	Y	30	(6)	8.5	36.3	6.8	34.5		H-2-64419
	3	0.75	Thermocouple for ALC 102-7	341.9	14.5	Y	0.75		9.4	36.1	8.0	35.5		H-2-64419
	2	6	Air Lift Circulator 102-8	40.6	14.5	Y	30	(6)	14.5	34.3	12.7	32.6		H-2-64419
	3	0.75	Thermocouple for ALC 102-8	35.4	14.5	Y	0.75		13.2	34.8	12.7	34.3		H-2-64419
	2	6	Air Lift Circulator 102-9	50.3	27.0	Y	30	(6)	21.3	44.4	19.6	42.7		H-2-64419
	3	0.75	Thermocouple for ALC 102-9	47.5	27.0	Y	0.75		20.3	44.9	19.7	44.4		H-2-64419
	2	6	Air Lift Circulator 102-10	76.6	27.0	Y	30	(6)	30.6	38.6	28.9	36.8		H-2-64419
	3	0.75	Thermocouple for ALC 102-10	73.8	27.0	Y	0.75		29.7	39.3	29.2	38.8		H-2-64419
	2	6	Air Lift Circulator 102-11	102.9	27.0	Y	30	(6)	38.4	30.8	36.7	29.0		H-2-64419
	3	0.75	Thermocouple for ALC 102-11	100.1	27.0	Y	0.75		37.7	31.7	37.2	31.2		H-2-64419
	2	6	Air Lift Circulator 102-12	129.2	27.0	Y	30	(6)	44.3	21.5	42.6	19.7		H-2-64419
	3	0.75	Thermocouple for ALC 102-12	126.4	27.0	Y	0.75		43.8	22.5	43.3	22.0		H-2-64419
	2	6	Air Lift Circulator 102-13	154.3	27.0	Y	30	(6)	47.8	11.9	46.0	10.2		H-2-64419
	3	0.75	Thermocouple for ALC 102-13	151.5	27.0	Y	0.75		47.5	13.0	47.0	12.5		H-2-64419
	2	6	Air Lift Circulator 102-14	181.7	27.0	Y	30	(6)	49.0	5.1	47.2	3.3		H-2-64419
	3	0.75	Thermocouple for ALC 102-14	178.9	27.0	Y	0.75		49.0	5.0	48.5	4.5		H-2-64419
	2	6	Air Lift Circulator 102-15	206.9	27.0	Y	30	(6)	47.7	12.4	45.9	10.6		H-2-64419
	3	0.75	Thermocouple for ALC 102-15	204.1	27.0	Y	0.75		47.9	11.3	47.4	10.8		H-2-64419
	2	6	Air Lift Circulator 102-16	230.4	27.0	Y	30	(6)	44.4	21.3	42.6	19.6		H-2-64419
	3	0.75	Thermocouple for ALC 102-16	227.6	27.0	Y	0.75		44.9	20.3	44.3	19.8		H-2-64419
	2	6	Air Lift Circulator 102-17	256.7	27.0	Y	30	(6)	38.6	30.7	36.8	28.9		H-2-64419
	3	0.75	Thermocouple for ALC 102-17	253.9	27.0	Y	0.75		39.3	29.7	38.7	29.2		H-2-64419
	2	6	Air Lift Circulator 102-18	282.9	27.0	Y	30	(6)	30.8	38.4	29.0	36.7		H-2-64419
	3	0.75	Thermocouple for ALC 102-18	280.1	27.0	Y	0.75		31.7	37.7	31.2	37.2		H-2-64419
	2	6	Air Lift Circulator 102-19	309.2	27.0	Y	30	(6)	21.5	44.3	19.7	42.6		H-2-64419

9/29/00

	No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Waste (Y/N)	Diam (in)	Notes	# (ft)	Mixer #3 (ft)	Mixer # (ft)	Mixer #3 (ft)	Equipment removed by W-521	Drawing
	3	0.75	Thermocouple for ALC 102-19	306.4	27.0	Y	0.75		22.5	43.8	22.0	43.3		H-2-64419
	2	6	Air Lift Circulator 102-20	334.3	27.0	Y	30	(6)	11.9	47.8	10.2	46.0		H-2-64419
	3	0.75	Thermocouple for ALC 102-20	331.5	27.0	Y	0.75		13.0	47.5	12.5	47.0		H-2-64419
•	2	6	Air Lift Circulator 102-21	357.9	27.0	Y	30	(6)	5.1	49.0	3.3	47.2		H-2-64419
•	3	0.75	Thermocouple for ALC 102-21	355.1	27.0	Y	0.75		5.4	49.0	4.6	48.4		H-2-64419
	2	6	Air Lift Circulator 102-22	26.8	27.0	Y	30	(6)	12.4	47.7	10.6	45.9		H-2-64419
	3	0.75	Thermocouple for ALC 102-22	23.9	27.0	Y	0.75		11.3	47.9	10.7	47.4		H-2-64419
	4A	20	Vent Exhaust (old)	37.0	25.0	N								
R&I	5A	4	Level Indicator (FIC)+D88	180.0	32.0	N							Multiple-Function Instrument Tree	H-2-85122, H-2-95413
	5B	4	Tank Pressure	0.0	32.0	N								
R&I •	6A	42	(New) Transfer Pump/Drop Leg	90	6.0	Y	10		22.8	22.8	21.9	21.9	Slurry Distributor	H-2-64421
	7A	42	Steam Coil	315.0	20.0	Y	42		16.2	38.8	13.9	36.6		H-2-34669
	8A	2	Condensate Addition	65.0	34.0	N								
	9A	4	Pump Pit Drain 02A	132.3	7.4	Y	4		27.6	17.9	26.9	17.2		H-2-64313 H-2-64419
•	10A	3	Sluice Pit Drain 02B	3.8	19.0	Y	3		3.3	41.0	2.7	40.4		H-2-64314 H-2-64448
•	10B	3	Sluice Pit Drain 02C	93.8	19.0	Y	3		30.0	28.1	29.4	27.5		H-2-64314 H-2-64448
•	10C	3	Sluice Pit Drain 02D	183.8	19.0	Y	3		41.0	3.3	40.4	2.7		H-2-64314 H-2-64448
•	10D	3	Sluice Pit Drain 02E	273.8	19.0	Y	3		28.1	30.0	27.5	29.4		H-2-64314 H-2-64448
•	11A	4	Leak Detection Pit Drain	48.8	32.0	Y	4		24.1	49.4	23.4	48.7		H-2-64406
	12A	4	High Level Probe - Manual Tape	65.0	22.0	N								
R/NR	13A	4	Spare	50.4	34.8	Y	4		26.8	51.6	26.1	51.0	Profile Thermocouple Probe	H-2-64368
R/NR	13B	4	Spare	140.4	34.8	Y	4		53.6	22.7	52.9	22.0	Profile Thermocouple Probe	H-2-64368
R/NR	13C	4	Spare	230.4	34.8	Y	4		51.6	26.8	51.0	26.1	Profile Thermocouple Probe	H-2-64368
R/NR	13D	4	Spare	320.4	34.8	Y	4		22.7	53.6	22.0	52.9	Profile Thermocouple Probe	H-2-64368
•	14A	6	Dry Well	30	12.5	Y	6		12.8	33.4	12.1	32.7		H-2-64419
	14B	6	Dry Well	150	12.5	Y	6		33.4	12.8	32.7	12.1		H-2-64419
	14C	6	Dry Well	270	12.5	Y	6		25.3	25.3	24.6	24.6		H-2-64419
	14D	6	Dry Well	48.8	34.8	Y	6		26.2	51.9	25.4	51.2		H-2-64419
	14E	6	Dry Well	139.8	34.8	Y	6		53.5	22.9	52.7	22.1		H-2-64419
	14F	6	Dry Well	228.8	34.8	Y	6		51.9	26.2	51.2	25.4		H-2-64419
	14G	6	Dry Well	318.8	34.8	Y	6		23.3	53.3	22.5	52.6		H-2-64419
|	15A	6	New Temperature Tree	34.6	12.5	N	6							
	15B	6	Sludge Measurement	154.6	12.5	N								
	15C	6	SHMS Vapor Probe	274.6	12.5	N								
	15D	6	Sludge Measurement	2.1	34.8	Y			12.8	56.8	12.3	56.3		H-2-94856
	15E	6	Tank Liquid Level LIT (ENRAF)	24.6	34.8	N								
	15F	6	Sludge Measurement	47.1	34.8	N								
|	15G	6	(New) Temperature Tree	69.6	34.8	N								
	15H	6	Sludge Measurement	92.1	34.8	Y			41.8	40.5	41.3	40.0		H-2-94856
	15I	6	3" DR-370	114.6	34.8	N								
	15J	6	Sludge Measurement	137.1	34.8	N								
|	15K	6	(New) Temperature Tree	159.6	34.8	N								
•	15L	6	Sludge Measurement	182.1	34.8	Y			56.8	12.8	56.3	12.3		H-2-94856
	15M	6	Spare	204.6	34.8	N								
	15N	6	Sludge Measurement/Tank Pr	227.1	34.8	N								
|	15O	6	(New) Temperature Tree	249.6	34.8	N								
	15P	6	Sludge Measurement	272.1	34.8	Y			40.5	41.8	40.0	41.3		H-2-94856
	15Q	6	Spare	294.6	34.8	N								
	15R	6	Vent Inlet	317.1	34.8	N								
|	15S	6	(New) Temperature Tree	339.6	34.8	N	6		16.0	55.0	15.5	54.5		
R/NR	16A	4	Spare	25.4	12.5	Y	4	(4)	12.0	33.7	11.3	33.1	Sludge Thermocouple	H-2-64368
R/NR	16B	4	Spare	145.4	12.5	Y	4	(4)	33.1	13.7	32.4	13.0	Sludge Thermocouple	H-2-64368
R/NR	16C	4	Spare	265.4	12.5	Y	4	(4)	26.2	24.4	25.5	23.7	Sludge Thermocouple	H-2-64368
R&I	22A	16	(New) Camera	337.5	20.0	Y			8.4	41.2	7.9	40.7	Level Indicator (FIC)	H-2-95413
	23A	4	Level Indicator	300.0	31.0	N								

R. No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Waste (Y/N)	Diam (in)	Notes	[illegible] # (ft)	Mixer #3 (ft)	Mixer # (ft)	Mixer #3 (ft)	Equipment removed by W-521	Drawing
24A	42	Vent Return	135.0	20.0	N								
30A	4	Annulus Pump Discharge	120.0	31.0	Y	4		46.1	27.6	45.5	27.0		H-2-63796
Wall	n/a	Closest Primary Tank Wall	n/a	37.5	Y	n/a		15.5	15.5	15.0	15.0		

Notes (1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
(6) Air lift circulators have inner pipe diameters of 6 inches (consistent with riser) and outer diameters of 30 inches
(7) Per WHC-SD-WM-RPT-025, Rev. 1
I Indicates W-521 equipment installed in an empty riser
R Indicates equipment must be removed from riser before W-521 equipment can be installed
R/NR Indicates existing equipment is to be removed and not replaced with new equipment
* *Indicates that this component has been analyzed for yield stress and deflection*

Tank: SY-101

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	90	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	270	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

	Riser No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Distance from nozzle to object edge Mixer #1 (ft)	Distance from nozzle to object edge Mixer #2 (ft)	Equipment removed by W-521	Drawing
	1	4	Enraf	60	20.0	N								
	2	4	Enraf	180	20.0	N								
*, ** R	3	4	Spare	300	20.0	Y	3.5/0.84		38.6	10.4	38.1	9.9	Vel Den Temp Tree	H-2-815016
	4	4	Spare (Bent)	30	20.0	N								
I *	5	12	(New) Temperature Tree	90	3.0	Y			17.0	23.0	16.5	22.5		
	6	4	Spare	150	20.0	N	4							
R&I	7	42	(New) Mixer Pump	90	20.0	Y	42	(2)	n/a	40.0	n/a	37.8	Transfer Pump & Pit	CVI 50071 (RPT-5117)
R&I	8	42	(New) Mixer Pump	270	20.0	Y	42	(2)	40.0	n/a	37.8	n/a	Multiport Riser Assy	H-2-821100 H-2-821101
	9	12	Vent Inlet	120	20.0	N								
	10	12	Vent Exhaust	240	20.0	N								
	11	4	Spare	150	28.0	N								
	12	4	Spare	210	28.0	N								
R&I *	13	42	(New) Transfer Pump/Drop Leg	270	3.0	Y	42	(3)	23.0	17.0	20.8	14.8	Mixer Pump	H-2-815006
R&I	14	12	(New) Camera	270	9.0	N	12	(3)					Radar Gauge	
*, ** R	15	4		300	28.0	Y	4	(4)	46.4	14.6	45.7	14.0	Vel Den Temp Tree	H-2-815016
	16	4	Drop Leg - Pressure Relief	90	6.0	N								
	17	4	Gas Monitor Probe	195	28.0	N								
*, ** R/I	18	4	Tank Pressure / Gas Monitor	0	28.0	Y	4		34.4	34.4	33.7	33.7	Multi-Functional Instr	H-2-85123
*, ** R	19	4	Spare	120	28.0	Y	4		14.6	46.4	14.0	45.7	Multi-Functional Instr	H-2-85123
	20	4	Manual Tape	240	28.0	N								
	21	4	Spare	330	20.0	N								
	22	4	Spare	0	10.0	N								
	24	20	Capped	5	27	N								
	25	20	Capped	180	27	N								
	Wall	n/a	Closest Primary Tank Wall	n/a	37.5	Y	n/a		17.5	17.5	17.0	17.0		

Notes (1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
I Indicates W-521 equipment installed in an empty riser
R Indicates equipment must be removed from riser before W-521 equipment can be installed
R/NR Indicates existing equipment is to be removed and not replaced with new equipment
* Indicates that this component has been analyzed for yield stress and deflectio
** R Removal of this component has been suggested by this report

9/29/00

Tank: SY-102

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	90	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	270	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

	Riser No.	Size (in)	W-521 Configuration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Distance from nozzle to object edge Mixer #1 (ft)	Distance from nozzle to object edge Mixer #2 (ft)	Equipment removed by W-521	Drawing
	1	4	Liquid Observation Well	60.0	20.0	Y	4		10.4	38.6	9.7	38.0		H-2-93715
	2	4	Sludge Measurement	180.0	20.0	N								H-2-38181
	3	4	Spare	300.0	20.0	N								
	4	4	ENRAF	30.0	20.0	N								
R&I *	5	12	(New) Temperature Tree	90.0	3.0	Y	6		17.0	23.0	16.3	22.3	Transfer Pump	H-2-75352 (7)
R/NR	6	4	Spare	150.0	20.0	Y	4	(4)	20.0	34.6	19.3	34.0	Thermo Couple Probe	H-2-34304
R&I	7	42	(New) Mixer Pump	90.0	20.0	Y	42	(2)	0.0	40.0	-2.3	37.8	Antisiphoning Slurry Distributor	H-14-103590
/	8	42	(New) Mixer Pump	270.0	20.0	Y	42	(2)	40.0	0.0	37.8	-2.3	Shield Plug	
	9	12	Vent Exhaust	120.0	20.0	N								
	10	12	Vent Inlet	240.0	20.0	N								
	11	4	Pressure Transmitter	150.0	28.0	N								
	12	4	Spare	210.0	28.0	N								
R&I *	13	42	(New) Transfer Pump	270.0	3.0	Y	30	(6)	23.0	17.0	21.3	15.3	Air Lift Circulator/Supernate Drop Leg	H-2-37782 , H-2-46202
/	14	12	(New) Camera	270.0	9.0	N								
	15	4	Flush Pit Floor & Seal Pot Drains	300.0	28.0	N	4							H-2-37778
	16	4	Supernate Dropleg Nozzle	90.0	6.0	N	4							H-2-37784
	17	4	O2D Drain Pit Floor Drain	195.0	28.0	Y	4		38.4	29.9	37.7	29.2		H-2-37809, H-2-37773
	18	4	Vapor Probe/SHMS Tie-in	0.0	28.0	N								
	19	4	Sludge Measurement	120.0	28.0	N								
	20	4	Manual Tape-Level Indicator	240.0	28.0	N								
	21	4	Spare	330.0	20.0	N								
	22	4	Spare	0.0	10.0	N								
*,** R	23	12	Spare	284.0	30.0	Y	4.5	(4)	49.6	11.6	49.0	11.0	Transfer Pump	H-2-70421 (8) Assy P-1
	24	20	Capped	5.0	27.0	N								
	25	20	Capped	180.0	27.0	N								

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
(6) Air lift circulators have inner pipe diameters of 6 inches (consistent with riser) and outer diameters of 30 inches
(7) Per WHC-SD-WM-RPT-025, Rev. 1
(8) Per G. Leshikar, this drawing should show similar configuration
/ Indicates W-521 equipment installed in an empty riser

9/29/00

R Indicates equipment must be removed from riser before W-521 equipment can be installed
R/NR Indicates existing equipment is to be removed and not replaced with new equipment
* Indicates that this component has been analyzed for yield stress and deflecti
** R Removal of this component has been suggested by this report

9/29/00

Tank: SY-103

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise
(ref., HNF-4162, Rev. 0)

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	90	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	270	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

	Riser No.	Size (in)	W-521 Confiuguration	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Distance from nozzle to object edge Mixer #1 (ft)	Distance from nozzle to object edge Mixer #2 (ft)	Equipment removed by W-521	Drawing
	1	4	Spare	60	20.0	N								
	2	4	Spare	180	20.0	N								
	3	4	Sludge Measurement	300	20.0	N								
	4	4	Enraf	30	20.0	N								
R&I *	5	12	(New) Temp Tree	90	3.0	Y	6		17.0	23.0	16.3	22.3	Transfer Pump	H-2-75352 (6)
R/NR	6	4	Spare	150	20.0	Y	4		20.0	34.6	19.3	34.0	Thermocouple Probe	H-2-34304
R&I	7	42	(New) Mixer Pump	90	20.0	Y	42	(2)	n/a	40.0	n/a	37.8	Camera/Instrument	H-2-131617
I	8	42	(New) Mixer Pump	270	20.0	Y	42	(2)	40.0	n/a	37.8	n/a	Shield Plug	
	9	12	Vent Inlet	120	20.0	N								
	10	12	Vent Exhaust	240	20.0	N								
	11	4	Pressure Transmitter	150	28.0	N								
	12	4	Spare	210	28.0	N								
R&I *	13	42	(New) Transfer Pump/Drop Leg	270	3.0	Y	42	(3)	23.0	17.0	20.8	14.8	Slurry Distributor	H-2-37782 H-2-46202
I	14	12	(New) Camera	270	9.0	N								
	15	4	Spare	300	28.0	N								
	16	4	Drop Leg - Pressure Relief	90	6.0	N								
	17	4	Spare	195	28.0	N								
*, ** R/I	18	4	Tank Pressure	0	28.0	Y	4		34.4	34.4	33.7	33.7	Multi-Functional Instr	H-2-85346 H-2-85122
	19	4	Sludge Measurement	120	28.0	N								
	20	4	Manual Tape	240	28.0	N								
	21	4	Spare	330	20.0	N								
	22	4	Sludge Measurement	0	10.0	N								
	24	20	Capped	5	27	N								
	25	20	Capped	180	27	N								
	Wall	n/a	Closest Primary Tank Wall	n/a	37.5	Y	n/a		17.5	17.5	17.0	17.0		

Notes (1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); actual pump likely to be larger
(2) Make and model of new mixer pumps have yet to be specified; diameter conservatively is taken diameter of riser
(3) Make and model of new transfer pump has yet to be specified; diameter conservatively is taken diameter of riser
(4) Component being removed from tank - not analyzed.
(5) Multi-port risers are installed with temperature trees only extending into the waste. Diameter of new temperature trees assumed to be 10 inches
(6) Per WHC-SD-WM-RPT-025, Rev. 1
I Indicates W-521 equipment installed in an empty riser
R Indicates equipment must be removed from riser before W-521 equipment can be installed
R/NR Indicates existing equipment is to be removed and not replaced with new equipment
* Indicates that this component has been analyzed for yield stress and defl
** R Removal of this component has been suggested by this report

9/29/00

Appendix B
Impingement Force Analysis

HNDTEAM

CALCULATION COVER SHEET
Form EP-3.3-1F

Page: 1 of 69 + Attachment 1

Date: 9/27/00

Calculation No: ME-07
Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis
Project No. & Title: ~~00-02-3.01~~ 99092030/4412-43 W-521 advanced Conceptual Waste Feed Delivery System

ORIGINAL AND REVISED CALCULATION/ANALYSIS APPROVAL

	Rev. A Name/Signature/Date	Rev. B Name/Signature/Date	Rev. C Name/Signature/Date
Originator:	Russ Spencer 8/17/00	Russ Spencer	Russell B. Spencer Russ Spencer 9/27/00
Checked By:	Denise Clements 8/17/00	Denise Clements	Denise Clements Denise Clements 9/28/00
Approved By:			
Other:			Mark Vanderzanden Mark Vanderzanden

AFFECTED DOCUMENTS

Document Number	Document Title	Rev. Number

RECORD OF REVISION

Rev.	*Reason for Revision*
A	Initial Issue
B	Incorporate internal comments
C	Incorporate client comments

HNDTEAM **DESIGN CALCULATION SHEET FORM EP-3.3-2F**	Project No. 9909203.01/4412-046 Sheet 2 of 69 + Attachment 1
Calculation No. ME-07	PERFORMED BY R. Spencer *Russell B. Spencer* DATE 9/27/00 Print/Sign Name D.Clements *D Clements* Date 9/28/00
Rev. No. C	CHECKED BY D. Clements *D Clements* DATE 9/26/00 Print/Sign Name *M. VanderZanden* M. Vanderzanden Date 9/28/00
Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	

INTRODUCTION

Purpose

The purpose of this analysis is to estimate the impingement forces on components located within Tanks AW-101, AW-103, AW-104, AY-101, AY-102, SY-101, SY-102 and SY-103 as a part of the Advanced Conceptual Design Report (ACDR) for the W-521 Project. These force estimates will then be compared against allowable yield forces for the components. The impingement forces will be used to determine component deflection for comparison against plastic-hinge limit load allowables. The comparison results will be the basis for requiring removal of components from the above tanks prior to operation of the mixer pumps.

Scope

The scope of this analysis is to perform a preliminary conceptual evaluation of the impingement forces and resulting deflection on the in-tank components that may be affected by exceeding yield allowables, or deflect such that the component interferes with other equipment or the tank wall. Forces and deflections will be estimated for pump flows resulting from 70% and 100% pump speed operation.

DESIGN BASIS

Design Inputs

Design inputs for this analysis are found in the documented references listed below.

Criteria

This analysis, as part of the ACDR, is determining criteria for the design of the W-521 Waste Feed Delivery System.

Assumptions

The assumptions of this analysis are the following:

1. The worst-case sludge build-up for analysis is 3 ½", which is added to the overall component diameter for an effective component diameter (Julyk 1997) and assumed over the entire length of the component.
2. The waste density is 1.4 g/cm^3 and the waste viscosity is 30 centipoise based on Level 2 Specification criteria.
3. The waste is assumed uniform throughout the tank fluid volume.
4. Allowable force for components that are not operational or will not be operational is yield, Sy.
5. Allowable force for components that must be operational is AISC (.66 Sy).
6. For deflection analysis the components are treated as cantilevers with constant cross-sectional properties.

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REFERENCES

AISC, 1989, *Manual of Steel Construction – Allowable Stress Design*, American Institute of Steel Construction, Inc. Chicago, Illinois.

Bambeger, J. A., J. M. Bates, and E. D. Waters, 1990, *Final Report: Experimental Characterization of Jet Static Forces Impacting Waste Tank Components*, PNL-7394, Pacific Northwest Laboratory, Richland, Washington.

Julyk, L. J., 1997, *Evaluation of the Effect of Project W-151 Mixer Pump Jets on In-Tank Equipment Considering Potential Sludge Buildup on Equipment in Waste Tank 241-AZ-101, Hanford Site Richland, Washington*, HNF-SD-W151-DA-008, Fluor Daniel Northwest, May 13, 1997.

Pilkey, D. W., 1994, *Formulas for Stress, Srain, and Structural Matrices*, John Wiley & Sons, Inc. New York, New York.

Roarke, R. J. 1965, *Formulas for Stress and Strain*, 4th Edition, McGraw-Hill Book Company, New York New York.

Trent, D. S. and L. A. Mahoney, 1994, *Simplified Procedure for Estimation Cross-Stream Jet Forces on Waste Tank Instrument Trees*, PNL MIT 030194, Pacific Northwest Laboratory, Richland, Washington.

Winkel, B. V. 1989, *Evaluation of the Effects of Mixer Pump Jets on Internal Components Resulting from Mixer Pump Operation in DST 101-AZ (Design Input)*, WHC-SD-W151-ER-001, Rev. 0, Westinghouse Hanford Company, Richland Washington.

Wood, R. F. and Tucker, R. P., 2000, *Completion of TPP FY/2000 PI ORP 4.2.1 Rev. 1 AZ101 Process Test Section 3 Stretch 4 and Section 4 Define Completion*, CHG-0002835, CH2M Hill Hanford Group, June 5, 20000.

METHODS

This calculation is prepared in three sections. Section 1 evaluates the estimated impingement forces on the components, Section 2 evaluates the estimated component deflections observed due to the impingement forces and determines the allowable plastic hinge limit load for the components, and Section 3 determines the allowable yield forces for the components evaluated.

The methods used in **Section 1** to perform this analysis are based on the basic equation of drag force on a solid body in a flowing fluid with uniform distribution. This equation is modified to model the diverging jet flow

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impinging on the vertical pipe components. This evaluation is performed as a static evaluation and dynamic load factors from Winkel 1989 are added to the allowable yield force calculations in Section 3.

A review of thermocouple tree removal videos from AZ-101 indicated a sludge buildup on the in-tank portion of thermocouple trees. The observed build-up was 2 ½" thick and therefore, for purposes of this analysis, a 3 ½" sludge build-up is conservatively assumed. The increase in diameter (7" total) increases the jet impingement area and also affects the effective drag coefficient of the component. The increased jet impingement area will proportionately increase the jet impingement load, thus making the 3 ½" sludge build-up a conservative assumption. The component (with sludge build-up) diameter is assumed uniform over the length of the component (Julyk 1997).

A conservative approach to evaluating the thermowells (3/4" pipe welded to the 30" ALC pipe) is to assume the force that is exposed on the 30" + 7" sludge ALC is what will be imposed on the thermowells. The force results from this calculation determined when assuming this conservative approach corresponds with Julyk 1997.

This analysis also evaluates the forces on only the ¾" thermowells with a conservative assumption of the 3 ½" sludge thickness added to the pipe (pole) diameter. The force results from a less conservative but more realistic model result in the thermowells being below the yield force allowable at 100% speed.

When the force of the pump is exerted on the ALC, the ALC will support the thermowell because of it's much higher allowable force. Therefore, assuming that the force on the ALC is the same as the force on the thermowell alone is a very conservative approach.

Additional conservatism built into this analysis is:

- For the deflection analysis, the velocity profile as shown below (Figure 1) is assumed a point load and modeled as impinging at the bottom of all components. The maximum velocity is actually at the center of the jet and the jet will be at least 18" from the bottom of the tank. Therefore, modeling the maximum force as a point load at the end of components that may be only 3" from the bottom of the tank is conservative. This conservatism will more than account for the velocity profile shift to the bottom of the tank for the interference and bounce back velocity from the bottom of the tank.

- Small deflection theory evaluation was used and has been determined to be conservative per Julyk and Winkel.

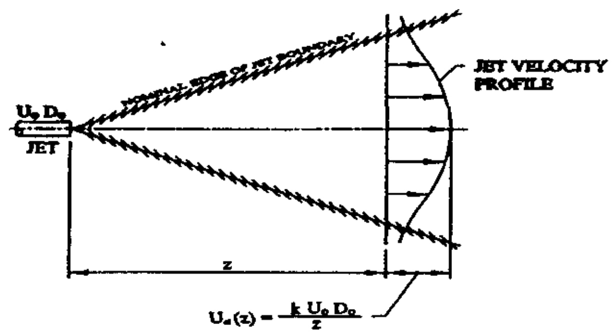

Figure 1, Velocity Profile

- For the deflection analysis the moment arm of all components is assumed to be the entire length of the component (except for the thermowells). This is conservative because several of the components are supported inside of risers and will actually have approximately a 10 foot shorter moment arm, which significantly lowers the deflection.
- Dynamic load factors (Winkel, 1989) were added to the allowable yield and AISC values.

The methods used in **Section 2** for determining deflections are based on simple cantilever beam equations directly from Roarke, 1965 for a constant cross-sectional property cantilever pipe with an assumed fixed point and free end exposed to a transverse point load. The allowable deflection is based upon the plastic-hinge limit load shape factor (Pilkey 1994 and Julyk 1997) for each component.

The components are assumed fixed at their respective points in the tanks as follows:

- Thermowells assumed fixed at bottom of ALC's. The thermowell ¾" pipe extends 27" past the end of the 30" diameter ALC (See page 5).
- The entire length of all remaining components is used as their respective moment arms.

The allowable deflection, derived per Julyk 1997 is based upon the plastic hinge limit. The component "limit" load which is associated with the creation of a plastic hinge, meaning that loads in excess of the limit load would produce significant permanent deformation is used as the assumed failure for this analysis and those components exceeding their limit load will either be this analysis and those components exceeding their limit load will either be removed or the pump reduced to such a speed when impinging upon them to maintain the stresses below the limit.

The stresses due to the impingement load at the riser to component flange location have also been evaluated to ensure the yield allowable is not exceeded at that (worst case) location. The worst case impingement forces on the ALC, RDW, sluice pit drain, new temperature tree, VDTT, new 11" transfer pump, new 32" transfer pump, and SY 102 supernate pump.

These yield stresses at the riser flange to component interface are then used to compare to the fatigue allowables found in Attachment 1. The maximum force for each component to reach it's allowable fatigue cycles is charted for various time periods in Attachment 1.

The methods used in **Section 3** for determining the allowable yield forces is the conversion of the allowable stress for A53, Grade A carbon steel to the allowable force based on the cross-sectional properties of each component.

A Dynamic Load Factor (DLF) (Winkel 1989) is added to allowable force determination to conservatively include dynamic loading of these components that were evaluated statically. The allowable force for the thermowells and ALCs is taken from Julyk, 1997 due to the similarity of the components.

RESULTS AND CONCLUSIONS

The results are evaluated by comparing the estimated force with the allowable yield force (based on the cross-sectional area of the component) and comparing the estimated deflection with the plastic-hinge limit load (based on the shape factor of the pipe). The plastic-hinge limit load evaluation is the limiting method of analysis in this evaluation. The yield load may be exceeded as long as the plastic-hinge limit load is not exceeded for the component. If the plastic-hinge limit load is exceeded but the yield load not exceeded, justification for acceptance of the component is not met.
The plastic-hinge limit load method more accurately (less conservatively) addresses the shape of the component instead of conservatively assuming only the cross-sectional area of the component. The impingement force may cause the component to bend more than plastic-hinge limit before reaching the components yield allowable. Therefore, the components that exceed their plastic-hinge limit load must be evaluated more extensively in definitive design or controls must be placed on the pump when in line with these components.

Based upon the several layers of conservatism this analysis has taken into account; small deflection theory calculations (per Julyk and Winkel), point load at bottom of components, entire length of component as moment arm, load integrated over entire diameter of component, and the additional 10% DLF added, as long as the components are less than the limit load they are assumed to remain in the tanks.

The profile temperature probes, LOWs and sludge temperature probes have been assumed to be removed based upon large deflections that could possibly impact the tank wall (Winkel 1989) and other Client considerations.

The results of this analysis determined the following (see Attachment 1 Tables):

- Using the conservative method, two thermowells (for ALC 14 & 21 in both AY-101 and AY-102) that are located less than 5 feet from the mixer pumps exhibit slightly higher than yield force allowables but are below their plastic-hinge limit load allowable.

- The worst case ALCs 14 and 21 located in riser 2 exceeds the yield stress allowable (100% pump speed) for the riser flange to component stress evaluation based upon the impingement force being determined on the 30" pipe and the pipe to flange being a 6" schedule 80 pipe. At 70% speed the stress is more than acceptable. Therefore, the pump should be slowed to 70% when in-line with ALC 14 & 21.

- The sluice pit and leak detection pit drains are below their yield and limit load allowable (at 70% speed) but exceed their plastic-hinge limit load and yield allowable at 100%. These components also exceed their yield stress allowable for the riser flange to component evaluation at 70% and 100%. These components are 5 feet from the bottom of the tank and are only of concern when the pump is being lowered past them, not during normal pump operation. In definitive design the speed of the pump may be lowered to less the 70% speed when being lowered past the end of the sluice pit and leak detection pit drains.

- The sluice pit drains also exceed their fatigue limit assuming that the pump were to be operating continuously 5 feet from the bottom of the tank. The 70% impingement force was determined to be 81 lbf and the maximum force to exceed yield stress at 20,000 cycles is 70.3 lbf (Attachment 1).

- The closest Radiation Dry Wells (RDW) (Risers 14a and 14b) in AY 101 (and similarly in AY 102) are below their yield and limit load allowable

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at 100% speed. Although concern was placed on these components based on the Julyk report, the additional 4.3 feet (12.3 feet from mixer pump verses the Julyk 8 foot from mixer pump) lowers the impingement force on this component significantly. This can be seen in the Julyk report also where 17.7 ft from the pump yields 74 lbf. Based upon the higher fluid viscosity required by the Level 2 specification for this project, this lower force also is logical. The RDW's do not exceed their yield stress allowable at 100% pump speed.

- The thermowells were thought to be the components of most concern because they are close to the pump and small in size, ¾" schedule 40 carbon steel pipe. However, the impingement force is smaller with the smaller diameter of pipe. Therefore, although the ¾" pipe has a lower allowable yield force it also has a lower impingement force. The ALC has higher impingement forces but can withstand higher forces (allowable yield force is 603 lbf). This analysis evaluates the force that will be exerted on the ALC (30" diameter) and the thermowell (3/4" diameter) and conservatively assumes the ALC force is exerted on the thermowell. The allowable force (154 lbf) for the thermowells is taken from Julyk 1997 based upon the similarity of these components to the AZ-101 thermowells.

- Using the conservative approach, the impingement forces on the ALC thermowells that are located less than 5 feet from the pumps exceed yield (at 70% speed) but they do not exceed their deflection limit load. Evaluating the impingement force on the thermowell instead of exposing the ¾" diameter pipe to the forces of a 30" diameter pipe lowers the impingement forces to below AISC allowables for 70% speed and below yield allowables at 100% speed. The limit load evaluation is considered the conservative methodology, therefore these components with the conservative approach and 70% pump speed are acceptable to remain in the tanks.

- The new 6" thermocouple trees are well below their AISC stress allowables, yield stress allowable at the riser to component interface, and limit load allowables for 100% pump speed.

- The multi-functional instrument trees (MITs) in SY 101 exceed their yield, AISC and limit allowable at 100% pump speed but do not exceed their yield and limit load allowable at 70% speed. Therefore, the pump speed must be reduced when in-line with the MITs. The MITs exceed the yield force allowable at the riser to component interface for 100% but are acceptable at 70%.

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- The Velocity Density Temperature Trees (VDTT) exceed their yield, AISC and allowables at 100% pump speed but do not exceed their limit load at100 % pump speed. They do not exceed their AISC and limit load allowable at 70% pump speed. Therefore, based upon the fact that it is desirable that the VDTT remain functional the pump speed will be reduced when the jet is in-line with the VDTTs. The VDTTs exceed the yield force allowable at the riser to component interface for 100% but are acceptable at 70% speed.

- The 11" and 32" conceptual design new transfer pumps are acceptable in all cases evaluated for 100% pump speeds in all tanks.

- The supernate feed pump in SY-102 does not exceed AISC or limit load allowables, nor does it exceed the yield force allowable for the riser to component interface for 100% pump speed.

- The sluice pit drains and leak detection pit drains in the AY tanks exceed their yield and limit allowable at 100% pump speed. The basis behind not removing the sluice pit drains or leak detection pit drains is as follows:

  a) The sluice pit and leak detection pit drains are welded to the tank dome and would be extremely difficult, if not impossible to remove from the tank.
  b) The impingement forces on the components do not exceed yield at 70% pump speed.
  c) The deflection does not exceed the limit load allowable at 70% pump speed.
  d) Further evaluation can be made during definitive design, once pump characteristics are finalized to determine the method of controls for lowering the pumps past the sluice pit drains.
  e) The drains are 5 feet above the bottom of the tank and therefore do not affect normal operation of the pump.

Attachment 1 tables give a compiled list of the force and deflection results for each of the components in each of the tanks.

The pumps must also be operationally controlled to not allow coincidental impingement on the components. As shown in the Julyk report the impingement forces from two pumps coincidentally being imposed on components are much too high for the components to resist.

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SECTION 1: Determine Maximum Force on In-Tank Components at 100% Pump Speed.

MAXIMUM FORCE ON PIPE

$g_c := 32.17$ Gravitational Constant with units

$\text{centipoise} := \frac{\text{poise}}{100}$ defined centipoise

$C_v := 47870$ centipoise/(lb_f -s/ft^2) conversion factor, for reference

$C_\rho := 62.428$ (lb_m/ft^3)/(g/cm^3) conversion factor, for reference

$\rho_g := 1.4$ Fluid Density, g/cm^3

$\mu_c := 30$ Fluid viscosity, centipoise Given by Level 2 specification

$\mu := \frac{\mu_c}{C_v}$ $\mu = 6.267\times 10^{-4}$ <--Ck on conversions--> $\rho := \rho_g \cdot C_\rho$ $\rho = 87.399\frac{ft^3}{lb}\frac{lb}{ft^3}$

$k := 6.2$

$K := 2 \cdot k^2$ $K = 76.88$ Flow momentum constant, unitless

$z_p := 1..50$ Distance from jet discharge to point of reference, ft.

$F_d := \frac{1}{2} \cdot \rho \cdot U^2 \cdot A \cdot \frac{C_d}{g_c}$ (1) Drag force on a solid body in a flowing fluid with uniform distribution.

$X := 29.4$ UoDo given by Level 2 specification

$U(r, z_p) := \frac{k \cdot X}{z_p} \cdot e^{-K \cdot \left(\frac{r}{z_p}\right)^2}$ (2) Velocity profile as function of radius, r (at distance z_p)

D_p = Impinged Pole Diameter

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$$Re(r,z_p,D_p) := \frac{(\rho \cdot U(r,z_p) \cdot D_p)}{\mu} \quad (3)$$

Reynolds Number as a function of local velocity $U(r,z_p)$

D_p = Impinged Pole (Pipe) Diameter

In order to perform the numerical integration, Cd(Re) needs to be expressed in a functional form. The drag coefficient, Cd(Re), is given empirically by (Trent 1994) as a function of the Reynold's number

$$g(r,z_p,D_p) := \log(Re(r,z_p,D_p),10)$$

Note: $\log_{10}(525) =$ $\log(525,10) = 2.72$ max

$$a(r,z_p,D_p) := 0.45 e^{\left[-0.32\cdot\left(g(r,z_p,D_p)-3.35\right)^2\right]}$$

$$b(r,z_p,D_p) := 0.69 e^{\left[-1.40\cdot\left(g(r,z_p,D_p)-4.80\right)^2\right]}$$

$$c(r,z_p,D_p) := 0.34 e^{\left[-7.00\cdot\left(g(r,z_p,D_p)-5.40\right)^2\right]}$$

$$w(r,z_p,D_p) := \left(0.75 - g(r,z_p,D_p)\right)\cdot\left[0.5 - \frac{\mathrm{atan}\left[0.24\left(g(r,z_p,D_p)-2\right)\right]}{\pi}\right]\ldots$$
$$+0.52 + a(r,z_p,D_p) + b(r,z_p,D_p) + c(r,z_p,D_p)$$

$$Cd(r,z_p,D_p) := 10^{w(r,z_p,D_p)}$$ Coefficient of Drag

$U_R := .1$ 10% defines boundary

Effective boundary radius of the nomibal jet given by Trent, 1994.

$$r_{max}(z_p) := z_p\sqrt{\frac{-\ln(U_R)}{K}} + \frac{D_o}{2} \quad (4)$$

$$r_{max}(z_p) := z_p\sqrt{\frac{-\ln(U_R)}{K}} \quad (5)$$

<— To Obtain F_D as Function of U_oD_o
[Eliminate $D_o/2$ Term, assumed small]

$r_{max}(1) = 0.173$

For the condition with a diverging jet flow impinging upon a component, a non-uniform flow exists, i.e., where the flow velocity varies with location on the project area of the component. The equation for the drag force (1) under these conditions becomes:

$$Fd = (1/2\ \rho/g_c)\int_A U^2\, C_d dA, \text{ lbf} \quad (11)$$

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$$F_d(z_p, D_p) := \frac{\rho \cdot D_p}{g_c} \cdot \left[\frac{(k \cdot X)}{z_p}\right]^2 \rightarrow 90268.128049775567298 \frac{D_p}{z_p^2}$$

<— Terms Outside of Integral in equation 11can be evaluated

Terms inside of the integral, (equation 11) for a component modeled as pipe of fixed diameter (Dp) are:

$$In(z_p, D_p) := \int_0^{r_{max}(z_p)} C_d(r, z_p, D_p) \cdot e^{-2 \cdot K \cdot \left(\frac{r}{z_p}\right)^2} dr$$

The drag force equation then becomes Equation (12)*Equation (13):

$$F_D(z_p, D_p) := F_d(z_p, D_p) \cdot In(z_p, D_p)$$

AY 101 Calculations (All F_D results are lbf)

$F_D(8.0, 3.08) = 352.197$

$F_D(8.4, 3.08) = 336.468$

$F_D(4.6, 3.08) = 595.921$

$F_D(4.5, 3.08) = 608.634$

$F_D(2.8, .83) = 276.239$

$F_D(12.4, 0.50) = 78.467$

$F_D(7.9, 0.50) = 87.477$

$F_D(4.5, 0.06) = 92.386$

$F_D(4.6, 0.06) = 92.295$

$F_D(8.0, 0.06) = 72.514$

$F_D(8.4, 0.06) = 69.698$

$F_D(4.5, 0.65) = 147.642$

$F_D(4.6, 0.65) = 145.076$

$F_D(8.0, 0.65) = 98.885$

$F_D(8.4, 0.65) = 96.258$

$F_D(7.9, 1.08) = 141.335$

$F_D(12.4, 1.08) = 102.983$

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Riser 6A New Transfer Pump 32" Mixer #1 & #3 $F_D(22.3, 3.25) = 148.703$

Riser 6A New Transfer Pump 1" Mixer #1 & #3 $F_D(22.3, 1.5) = 89.802$

Riser 11A Leak Detection Pit Drain Mixer #1 $F_D(48.9, .92) = 88.444$

Riser 11A Leak Detection Pit Drain Mixer #3 $F_D(24.1, .92) = 78.287$

Riser 13A Profile Thermocouple Probe Mixer #1 $F_D(21.6, .92) = 78.834$

Riser 13A Profile Thermocouple Probe Mixer #3 $F_D(53.3, .92) = 90.114$

Riser 13B Profile Thermocouple Probe Mixer #1 $F_D(50.8, .92) = 89.214$

Riser 13B Profile Thermocouple Probe Mixer #3 $F_D(26.9, .92) = 78.47$

Riser 13C Profile Thermocouple Probe Mixer #1 $F_D(53.3, .92) = 90.114$

Riser 13C Profile Thermocouple Probe Mixer #3 $F_D(21.6, .92) = 78.834$

Riser 13D Profile Thermocouple Probe Mixer #1 $F_D(26.9, .92) = 78.47$

Riser 13D Profile Thermocouple Probe Mixer #3 $F_D(50.8, .92) = 89.214$

Riser 15A New Thermocouple Mixer #1 $F_D(13.3, 1.08) = 98.852$

Riser 15A New Thermocouple Mixer #3 $F_D(33.3, 1.08) = 78.805$

Riser 15D New Thermocouple Mixer #1 $F_D(56.3, 1.08) = 88.037$

Riser 15D New Thermocouple Mixer #3 $F_D(12.4, 1.08) = 102.983$

Riser 15H New Thermocouple Mixer #1 $F_D(40, 1.08) = 81.058$

Riser 15H New Thermocouple Mixer #3 $F_D(41.3, 1.08) = 81.601$

Riser 15L New Thermocouple Mixer #1 $F_D(12.3, 1.08) = 103.489$

Riser 15L New Thermocouple Mixer #3 $F_D(56.3, 1.08) = 88.037$

Riser 15P New Thermocouple Mixer #1 $F_D(41.3, 1.08) = 81.601$

Riser 15P New Thermocouple Mixer #3 $F_D(40, 1.08) = 81.058$

Riser 16A Sludge Temperature $F_D(33.2, .92) = 80.646$

Riser 16A Sludge Temperature Mixer #3 $F_D(13.2, .92) = 91.291$

HNDTEAM	**DESIGN CALCULATION SHEET** **Form EP-3.3-2F**	Calc. #:ME-07 Rev: C Page: 13 of 69

Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer RS	Date: 9/27/00
Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System	Checker: D.Clements	Date:

Riser 16B Sludge Temperature Mixer #1 $F_D(13.5,.92) = 90.338$

Riser 16B Sludge Temperature Mixer #3 $F_D(32.9,.92) = 80.508$

Riser 14G Dry Well Mixer #1 $F_D(53.4, 1.08) = 86.898$

Riser 14B Dry Well Mixer #3 $F_D(12.1, 1.08) = 104.531$

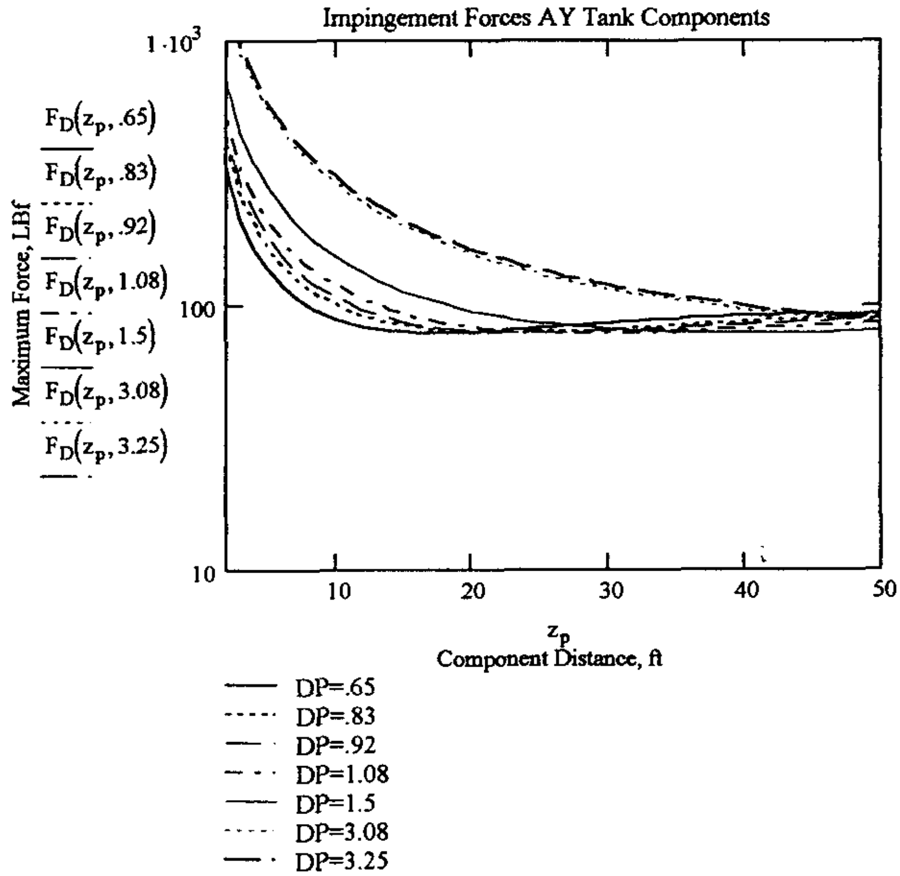
Riser 14A Dry Well Mixer #1 $F_D(32.9, 1.08) = 78.715$

Riser 14A Dry Well Mixer #3 $F_D(12.3, 1.08) = 103.489$

Riser 14B Dry Well Mixer #1 $F_D(12.3, 1.08) = 103.489$

Riser 14B Dry Well Mixer #3 $F_D(32.9, 1.08) = 78.715$

Riser 14C Dry Well Mixer #1 & #3 $F_D(24.8, 1.08) = 79.038$



HNDTEAM	**DESIGN CALCULATION SHEET** **Form EP-3.3-2F**	Calc. #:ME-07 Rev: C Page: 14 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer RS	Date: 9/27/00
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AW 101 Tank (Bounds all AW Tanks)

New Temp tree riser 5 Mixer #1 $F_D(22.5, 1.08) = 80.31$

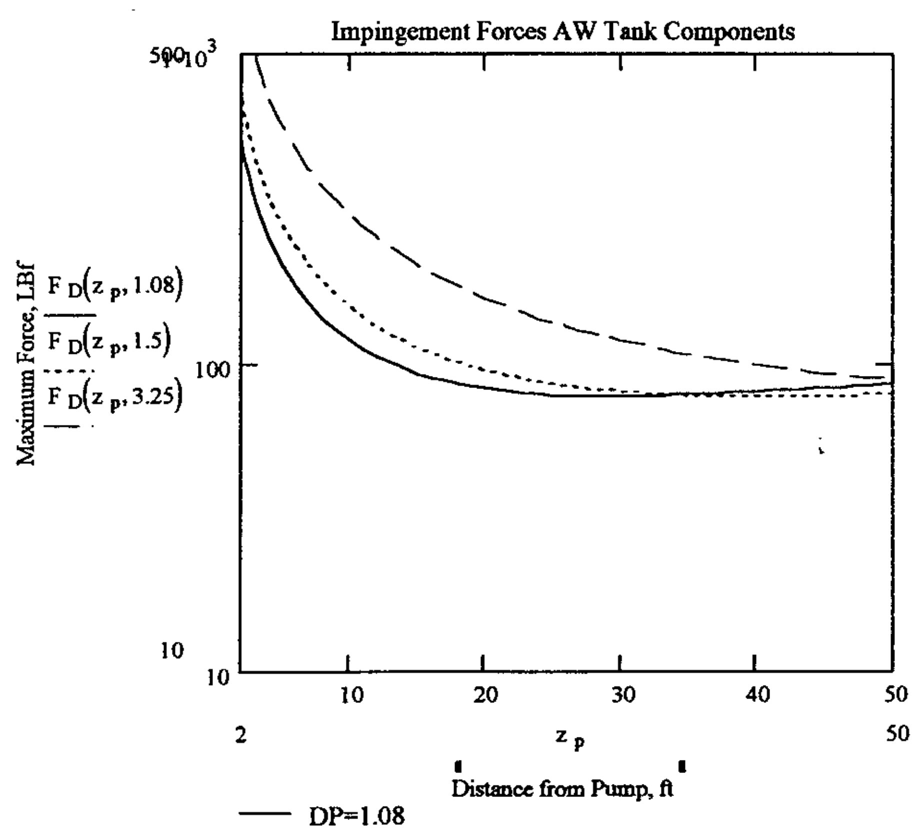
New Temp tree riser 5 Mixer #2 $F_D(16.5, 1.08) = 88.726$

New Transfer Pump Mixer 11" Mixer #1 $F_D(16.5, 1.5) = 105.727$

New Transfer Pump Mixer 11" Mixer #3 $F_D(22.5, 1.5) = 89.444$

New Transfer Pump Mixer 32" Mixer #1 $F_D(16.5, 3.25) = 191.45$

New Transfer Pump Mixer 32" Mixer #3 $F_D(22.5, 3.25) = 147.642$



HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 15 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer RS	Date: 9/27/00
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SY 101 Tank (Bounds SY 103 Tank)

Riser 3 Vel Den Temp Tree Mixer #1 $F_D(38.1, 0.875) = 84.137$

Riser 3 Vel Den Temp Tree Mixer #2 $F_D(9.9, 0.875) = 103.904$

Riser 5 New Temp Tree Mixer #1 $F_D(16.5, 1.08) = 88.726$

Riser 5 New Temp Tree Mixer #2 $F_D(22.5, 1.08) = 80.31$

Transfer Pump 32" Mixer #1 $F_D(22.5, 3.25) = 147.642$

Transfer Pump 32" Mixer #2 $F_D(16.5, 3.25) = 191.45$

Transfer Pump 11" Mixer #1 $F_D(22.5, 1.5) = 89.444$

Transfer Pump 11" Mixer #2 $F_D(16.5, 1.5) = 105.727$

Vel Den Temp Tree Riser 15 Mixer #1 $F_D(45.9, .875) = 88.169$

Vel Den Temp Tree Riser 15 Mixer #2 $F_D(14.1, .875) = 86.785$

MIT Riser #18 Mixer #1 & #2 $F_D(33.9, .875) = 81.834$

MIT Riser #19 Mixer #1 $F_D(14.1, .875) = 86.785$

MIT Riser #19 Mixer #2 $F_D(45.9, .875) = 88.169$

SY 102 TANK

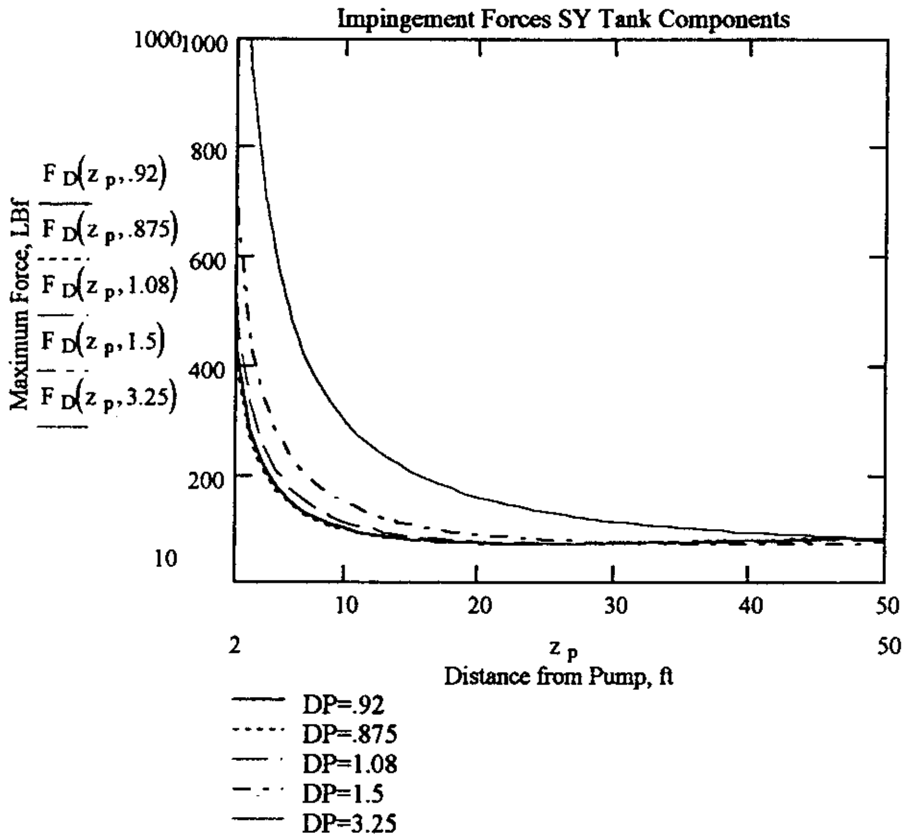
Riser 1 Liquid Observation Well Mixer #1 $F_D(9.9, .92) = 107.201$

Riser 1 Liquid Observation Well Mixer #3 $F_D(38.1, .92) = 83.105$

Riser 23 Transfer Pump Mixer #1 $F_D(49.1, .96) = 87.631$

Riser 23 Transfer Pump Mixer #3 $F_D(11.1, .96) = 102.549$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 16 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis		Orig: R. Spencer RS Date: 9/27/01
Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System		Checker: D.Clements Date: 9/28/00 DWC



HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 17 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System		Orig: R. Spencer *RS* Date: *9/27/00* Checker: D.Clements *DMC* Date: *9/26/00*

WALL FORCE AS FUNCTION OF U_oD_o

The equation for the force on the tank wall for a uniform (constant) velocity distribution is given by:

$F_w=(\rho/2g_c)U^2A$, lbf (14)

For a non-uniform velocity Equation (14) becomes:

$F_w = (\rho/2g_c)\ U(r,z)^2\ dA$, lbf (15)

$$r_{max}(z) := z\cdot\sqrt{\frac{-\ln(U_R)}{K}} + \frac{D_o}{2}$$ Defining r_{max} as a function of z Equation (4) above is used.

$U_R := .1$ assumption

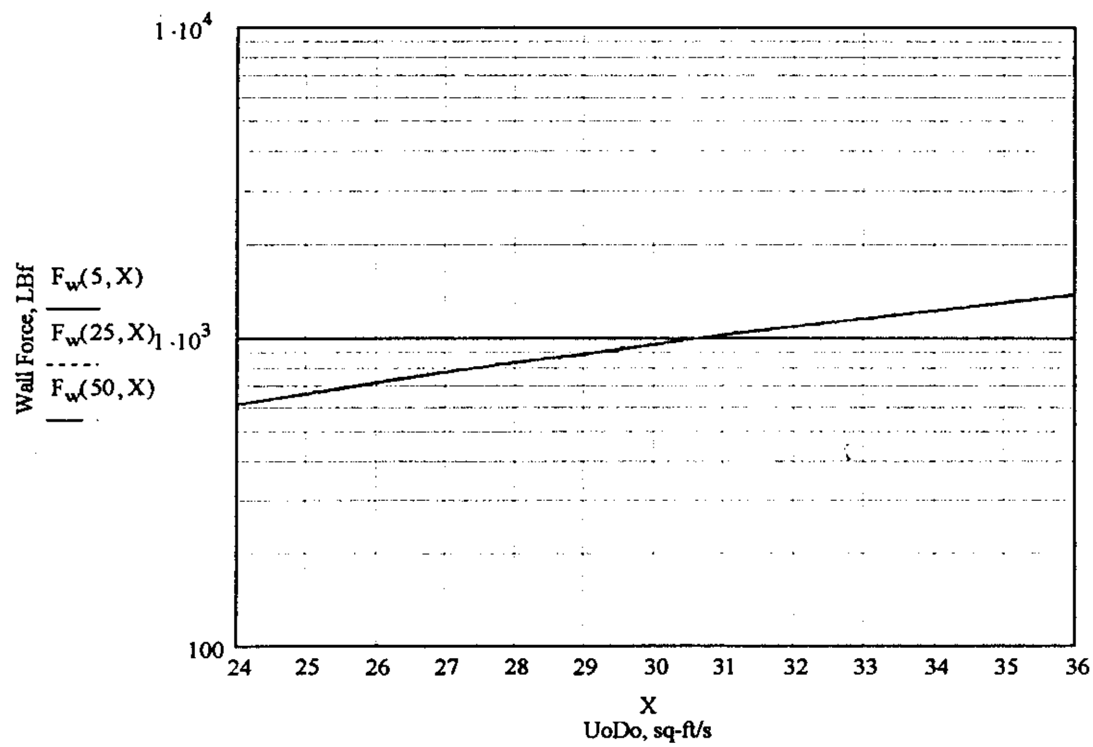
$$r_{max}(z) := z\cdot\sqrt{\frac{-\ln(U_R)}{K}}$$ <— New Expression to get r_{max} = Function of U_oD_o

$X := U_o\cdot D_o$ $\quad$ $X := 24..36$

Substituting equation (2) for U(r.z) equation (15) becomes:

$$F_w(z,X) := \left(\frac{\pi\cdot\rho}{g_c}\right)\cdot\left(\frac{k\cdot X}{z}\right)^2\cdot\int_0^{r_{max}(z)} e^{-2\cdot K\cdot\left(\frac{r}{z}\right)^2}\, r\, dr$$

Wall Impact Force as a Function of UoDo



$F_w(15.5, 29.4) = 912.948$

HNDTEAM	**DESIGN CALCULATION SHEET** Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 18 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer RBS	Date: 9/27/00
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MAXIMUM FORCE ON PIPE -- 70% Pump Speed

At 70 % Pump Speed; UoDo Reduced from 29.4 by 52%. A ratio of 11.54 cu-ft/sec to about 6.0 cu-ft/sec. This ratio is based on discussion with pump vendor.

$X := 29.4 0.52$

$X = 15.288$

$$U(r,z_p) := \frac{k \cdot X}{z_p} \cdot e^{-K \cdot \left(\frac{r}{z_p}\right)^2} \qquad (3)$$ Velocity profile as function of radius, r (at distance z_p)

$$Re(r,z_p,D_p) := \frac{(\rho \cdot U(r,z_p) \cdot D_p)}{\mu}$$ Reynolds Number as a function of local velocity $U(r,z_p)$

D_p = Impinged Pole (Pipe) Diameter

In order to perform the numerical integration, Cd(Re) needs to be expressed in a functional form. The drag coefficient, Cd(Re), is given empirically by (Trent 1994) as a function of the Reynold's number

$g(r,z_p,D_p) := \log(Re(r,z_p,D_p),10)$ Note: $\log_{10}(525) =$ $\log(525,10) = 2.72$ max

$$a(r,z_p,D_p) := 0.45 e^{\left[-0.32 \cdot (g(r,z_p,D_p)-3.35)^2\right]}$$

$$b(r,z_p,D_p) := 0.69 e^{\left[-1.40 \cdot (g(r,z_p,D_p)-4.80)^2\right]}$$

$$c(r,z_p,D_p) := 0.34 e^{\left[-7.00 \cdot (g(r,z_p,D_p)-5.40)^2\right]}$$

$$w(r,z_p,D_p) := (0.75 - g(r,z_p,D_p)) \cdot \left[0.5 - \frac{\operatorname{atan}[0.24(g(r,z_p,D_p) - 2)]}{\pi}\right] \ldots \\ + 0.52 + a(r,z_p,D_p) + b(r,z_p,D_p) + c(r,z_p,D_p)$$

$$C_d(r,z_p,D_p) := 10^{w(r,z_p,D_p)}$$ Coefficient of Drag

HNDTEAM	**DESIGN CALCULATION SHEET** Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 19 of 69

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$U_R := .1$ 10% defines boundary

Effective boundary radius of the nominal jet given by Trent, 1994.

$$r_{max}(z_p) := z_p \sqrt{\frac{-\ln(U_R)}{K}} + \frac{D_o}{2} \qquad (4)$$

$$r_{max}(z_p) := z_p \sqrt{\frac{-\ln(U_R)}{K}} \qquad (5)$$

<--- To Obtain F_D as Function of $U_o D_o$
[Eliminate $D_o/2$ Term, assumed small]

$r_{max}(1) = 0.173$

For the condition with a diverging jet flow impinging upon a component, a non-uniform flow exists, i.e., where the flow velocity varies with location on the project area of the component. The equation for the drag force (1) under these conditions becomes:

Fd= $(1/2\ \rho/g_c)\ U^2 C_d dA$, lbf (11)

Terms outside of the integral in equation 11 can be evaluated.

$$F_d(z_p, D_p) := \frac{\rho \cdot D_p}{g_c} \cdot \left[\frac{(k \cdot X)}{z_p}\right]^2 \rightarrow 24408.501824659313397 \frac{D_p}{z_p^{\,2}} \qquad (12)$$

$$In(z_p, D_p) := \int_0^{r_{max}(z_p)} C_d(r, z_p, D_p) \cdot e^{-2 \cdot K \cdot \left(\frac{r}{z_p}\right)^2} dr \qquad (13)$$

Terms inside of the integral, (equation 11) for a component modeled as a pipe of fixed diameter (D_p) are:

The drag force equaiton then becomes Equation(12)* Equation (13):

$$F_D(z_p, D_p) := F_d(z_p, D_p) \cdot In(z_p, D_p) \qquad (14)$$

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Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System	Orig: R. Spencer RS Date: 9/27/00 Checker: D.Clements DMC Date: 9/28/00	

AY 101 Added Calculations

$F_D(8.0, 3.08) = 100.974$

$F_D(8.4, 3.08) = 96.789$

$F_D(4.6, 3.08) = 166.714$

$F_D(4.5, 3.08) = 170.165$

$F_D(2.8, .83) = 80.922$

$F_D(12.4, 0.50) = 44.776$

$F_D(7.9, 0.50) = 40.922$

$F_D(4.5, 0.06) = 35.342$

$F_D(4.6, 0.06) = 34.676$

$F_D(8.0, 0.06) = 20.436$

$F_D(8.4, 0.06) = 19.501$

$F_D(4.5, 0.65) = 49.272$

$F_D(4.6, 0.65) = 48.718$

$F_D(8.0, 0.65) = 40.959$

$F_D(8.4, 0.65) = 40.797$

$F_D(7.9, 1.08) = 47.924$

$F_D(12.4, 1.08) = 41.327$

Riser 6A New Transfer Pump 32" Mixer #1 & #3	$F_D(22.3, 3.25) = 49.502$
Riser 6A New Transfer Pump 11" Mixer #1 & #3	$F_D(22.3, 1.5) = 40.755$
Riser 11A Leak Detection Pit Drain Mixer #1	$F_D(48.9, .92) = 44.626$
Riser 11A Leak Detection Pit Drain Mixer #3	$F_D(24.1, .92) = 45.398$
Riser 13A Profile Thermocouple Probe Mixer #1	$F_D(21.6, .92) = 44.154$
Riser 13A Profile Thermocouple Probe Mixer #3	$F_D(53.3, .92) = 42.675$
Riser 13B Profile Thermocouple Probe Mixer #1	$F_D(50.8, .92) = 43.808$
Riser 13B Profile Thermocouple Probe Mixer #3	$F_D(26.9, .92) = 46.574$
Riser 13C Profile Thermocouple Probe Mixer #1	$F_D(53.3, .92) = 42.675$
Riser 13C Profile Thermocouple Probe Mixer #3	$F_D(21.6, .92) = 44.154$
Riser 13D Profile Thermocouple Probe Mixer #1	$F_D(26.9, .92) = 46.574$
Riser 13D Profile Thermocouple Probe Mixer #3	$F_D(50.8, .92) = 43.808$

HNDTEAM	**DESIGN CALCULATION SHEET** Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 21 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer RS	Date: 9/27/00
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Riser 15A New Thermocouple Mixer #1 $F_D(13.3, 1.08) = 40.957$

Riser 15A New Thermocouple Mixer #3 $F_D(33.3, 1.08) = 47.066$

Riser 15D New Thermocouple Mixer #1 $F_D(56.3, 1.08) = 45.012$

Riser 15D New Thermocouple Mixer #3 $F_D(12.4, 1.08) = 41.327$

Riser 15H New Thermocouple Mixer #1 $F_D(40, 1.08) = 48.045$

Riser 15H New Thermocouple Mixer #3 $F_D(41.3, 1.08) = 48.059$

Riser 15L New Thermocouple Mixer #1 $F_D(12.3, 1.08) = 41.381$

Riser 15L New Thermocouple Mixer #3 $F_D(56.3, 1.08) = 45.012$

Riser 15P New Thermocouple Mixer #1 $F_D(41.3, 1.08) = 48.059$

Riser 15P New Thermocouple Mixer #3 $F_D(40, 1.08) = 48.045$

Riser 16A Sludge Temperature $F_D(32.6, .92) = 47.938$

Riser 16A Sludge Temperature Mixer #3 $F_D(13.2, .92) = 40.708$

Riser 16B Sludge Temperature Mixer #1 $F_D(13.5, .92) = 40.733$

Riser 16B Sludge Temperature Mixer #3 $F_D(32.9, .92) = 47.968$

HNDTEAM	**DESIGN CALCULATION SHEET** **Form EP-3.3-2F**	Calc. #:ME-07 Rev: C Page: 22 of 69

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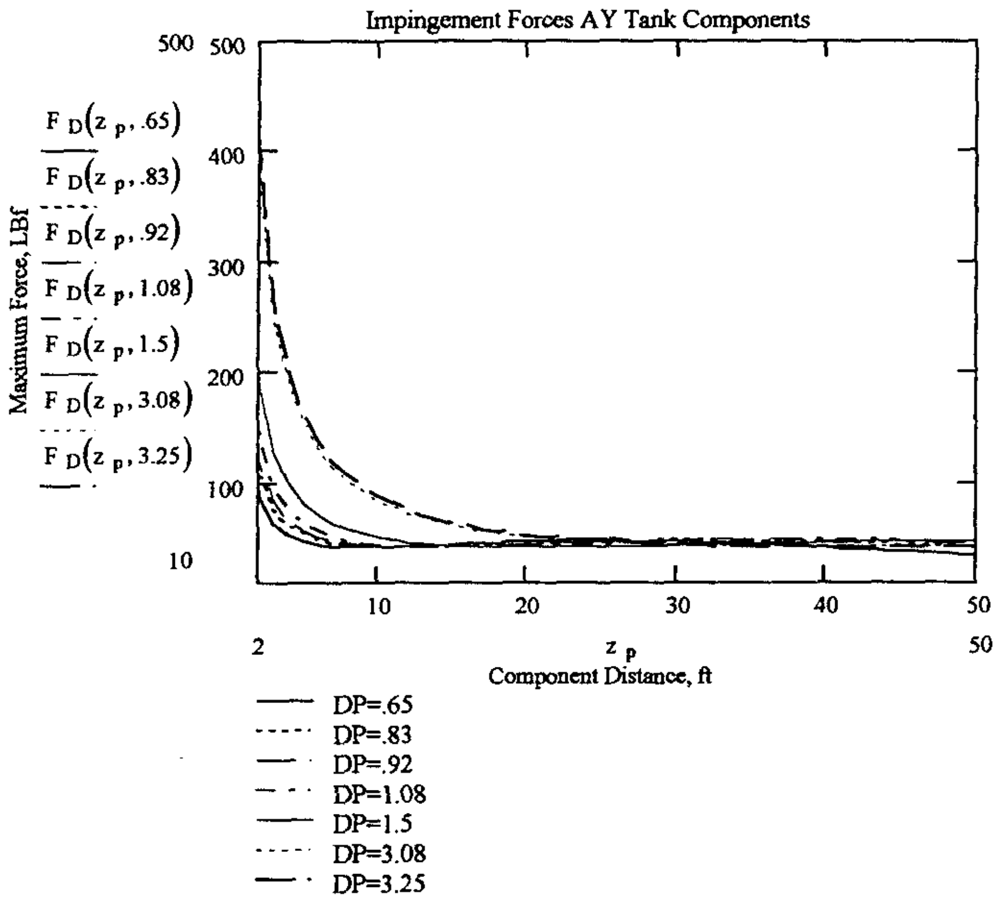
Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System	Checker: D.Clements DWC	Date: 9/28/00



HNDTEAM	**DESIGN CALCULATION SHEET** Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 23 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer RS	Date: 9/27/00
Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System	Checker: D.Clements DMC	Date: 9/28/00

AW 101 Tank (Bounds all AW Tanks)

New Temp tree riser 5 Mixer #1 $F_D(22.5, 1.08) = 42.877$

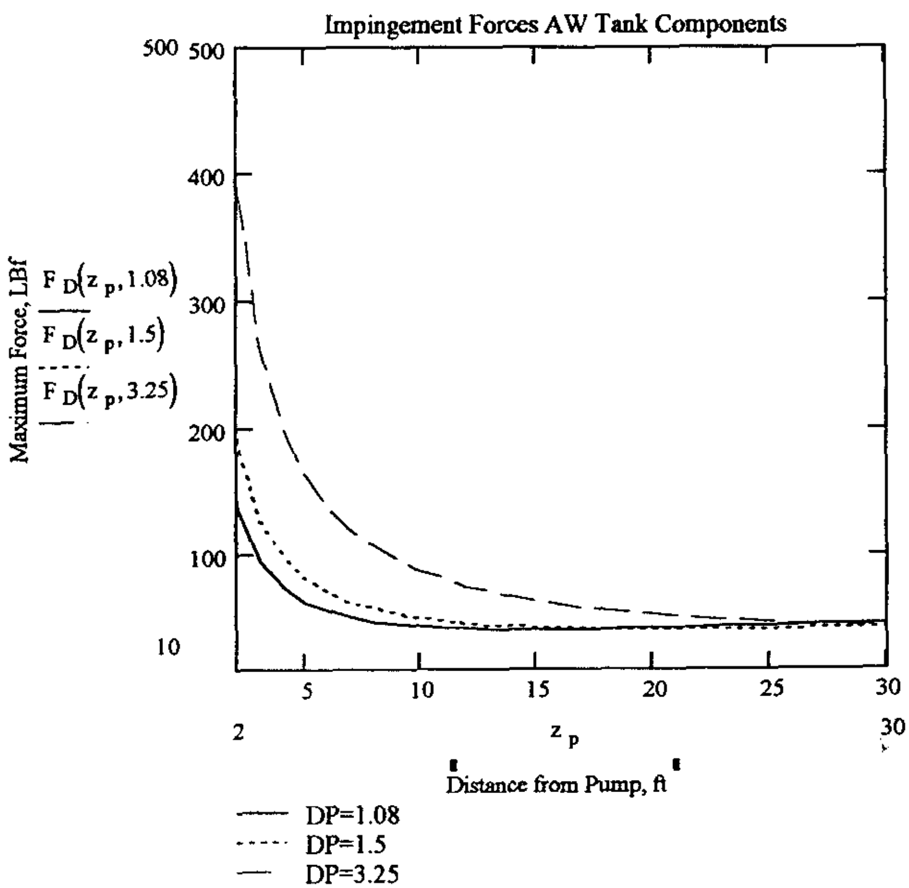
New Temp tree riser 5 Mixer #2 $F_D(16.5, 1.08) = 40.817$

New Transfer Pump Mixer 11" Mixer #1 $F_D(16.5, 1.5) = 41.636$

New Transfer Pump Mixer 11" Mixer #3 $F_D(22.5, 1.5) = 40.773$

New Transfer Pump Mixer 32" Mixer #1 $F_D(16.5, 3.25) = 59.429$

New Transfer Pump Mixer 32" Mixer #3 $F_D(22.5, 3.25) = 49.272$



HNDTEAM	**DESIGN CALCULATION SHEET** **Form EP-3.3-2F**	Calc. #:ME-07 Rev: C Page: 24 of 69

Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer RBS Date: 9/27/00
Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System	Checker: D.Clements DMC Date: 9/28/00

SY 101 Tank (Bounds SY 103 Tank)

Vel Den Temp Tree Mixer #1 $F_D(38.1, 0.92) = 47.845$

Vel Den Temp Tree Mixer #2 $F_D(9.9, 0.92) = 41.819$

New Temp Tree Mixer #1 $F_D(16.5, 1.08) = 40.817$

New Temp Tree Mixer #2 $F_D(22.5, 1.08) = 42.877$

Transfer Pump 32" Mixer #1 $F_D(22.5, 3.25) = 49.272$

Transfer Pump 32" Mixer #2 $F_D(15.7, 3.25) = 61.504$

Transfer Pump 11" Mixer #1 $F_D(22.5, 1.5) = 40.773$

Transfer Pump 11" Mixer #2 $F_D(16.5, 1.5) = 41.636$

Vel Den Temp Tree Riser 15 Mixer #1 $F_D(45.9, .92) = 45.806$

Vel Den Temp Tree Riser 15 Mixer #2 $F_D(14.1, .92) = 40.825$

MIT Riser #18 Mixer #1 & #2 $F_D(33.9, .92) = 48.037$

MIT Riser #19 Mixer #1 $F_D(14.1, .92) = 40.825$

MIT Riser #19 Mixer #2 $F_D(45.9, .92) = 45.806$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 25 of 69
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Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System		Checker: D.Clements DKC Date: 9/26/00

SY 102 TANK

New Temp Tree Mixer #1 $F_D(16.5, 1.08) = 40.817$

New Temp Tree Mixer #2 $F_D(22.5, 1.08) = 42.877$

Transfer Pump 32" Mixer #1 $F_D(22.5, 3.25) = 49.272$

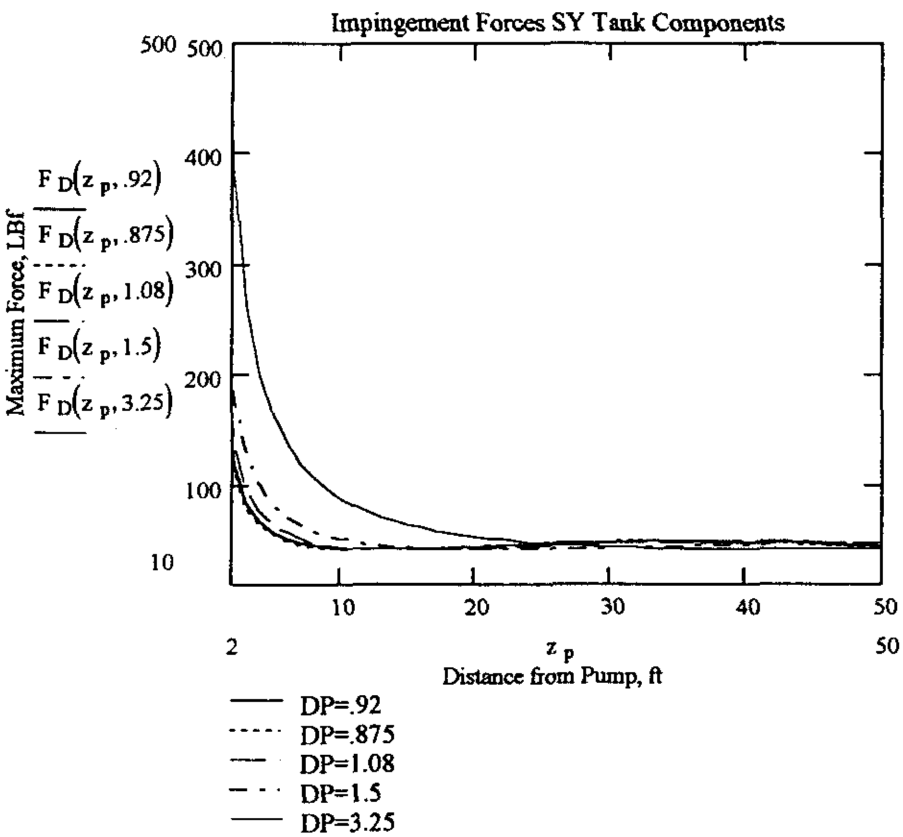
Transfer Pump 32" Mixer #2 $F_D(15.7, 3.25) = 61.504$

Transfer Pump 11" Mixer #1 $F_D(22.5, 1.5) = 40.773$

Transfer Pump 11" Mixer #2 $F_D(16.5, 1.5) = 41.636$

Supernate Dropleg Nozzle Mixer #1 $F_D(13.5, .875) = 40.844$

Supernate Dropleg Nozzle Mixer #3 $F_D(25.5, .875) = 46.541$



HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 26 of 69
Design Calculation Title: W-521 In Tank Component Impingement and Deflection Analysis		Orig: R. Spencer RS Date: 9/27/00
Project No. & Title: 4412-046, W-521 Advanced Conceptual Waste Feed Delivery System		Checker: D.Clements DMC Date: 9/28/00

WALL FORCE AS FUNCTION OF U_oD_o

The equation for the force on the tank wall for a uniform (constant) velocity distribution is given by:

$F_w=(\rho/2g_c)U^2A$, lbf (14)

For a non-uniform velocity Equation (14) becomes:

$F_w = (\rho/2g_c)\ U(r,z)^2\ dA$, lbf (15)

$$r_{max}(z) := z\cdot\sqrt{\frac{-\ln(U_R)}{K}} + \frac{D_o}{2}$$

Defining r_{max} as a function of z Equation (4) above is used.

$U_R := .1$ assumption

$$r_{max}(z) := z\cdot\sqrt{\frac{-\ln(U_R)}{K}}$$

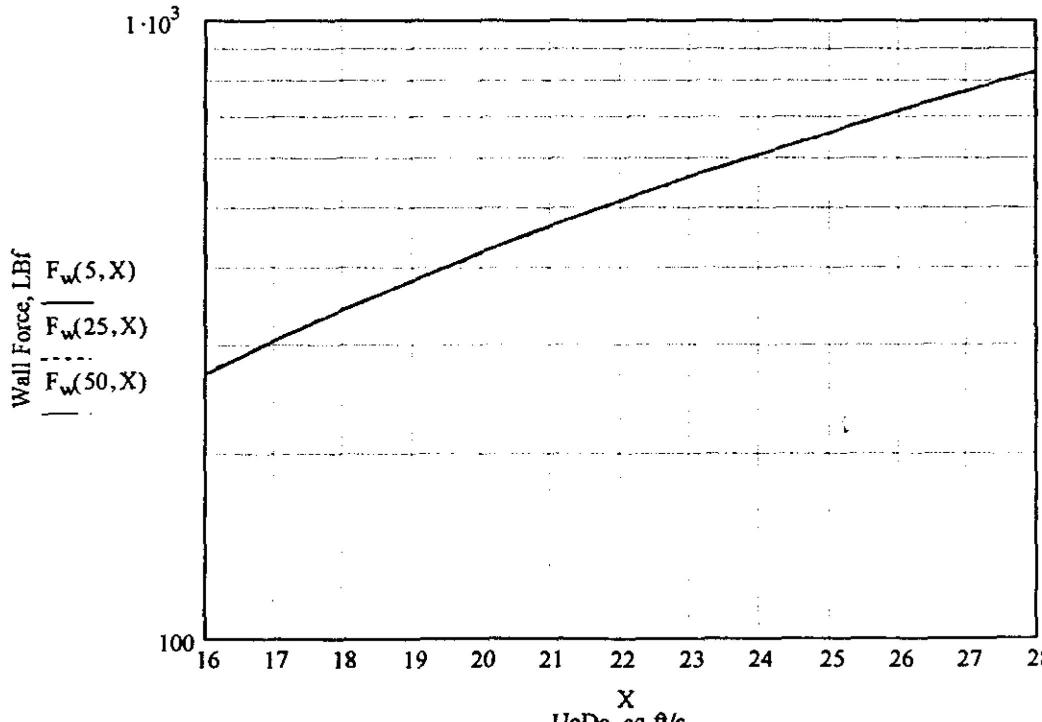
<— New Expression to get r_{max} = Function of U_oD_o

$X := U_o\cdot D_o$ $X := 16..28$

Substituting equation (2) for U(r.z) equation (15) becomes:

$$F_w(z,X) := \left(\frac{\pi\cdot\rho}{g_c}\right)\cdot\left(\frac{k\cdot X}{z}\right)^2\cdot\int_0^{r_{max}(z)} e^{-2\cdot K\cdot\left(\frac{r}{z}\right)^2} r\,dr$$

WALL IMPACT FORCE (F_w) AS FUNCTION OF U_oD_o (X)



$F_w(15.5, 15.288) = 246.861$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 27 of 69 + Attachment1
Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System	Orig: D. Clements D. Clements Date: 9/27/00 Checker: M. Vanderzanden MV Vanderzanden Date: 9/27/00	

SECTION 2: DEFLECTION ANALYSIS

Define component properties

Inner diameters of components:

$D_{ialc} := 19.376\,in$ Inner diameter of ALC

$D_{itemp} := 15.25\,in$ Inner diameter of temperature tree

$D_{idrain} := 3.068\,in$ Inner diameter of sluice pit drain

$D_{ithermowell} := 0.824\,in$ Inner diameter of thermowells

$D_{iLDPD} := 4.026\,in$ Inner diameter of leak detection pit drain 4" sch 40 pipe

$D_{isludge} := 0.824\,in$ Inner diameter of sludge temperature

$D_{iprofile} := 3.58\,in$ Assume 3 1/2" pipe (top half) to go with impingement force on 4" assumed 4" diameter pipe.

$D_{iVDTT} := 2.9\,in$ *VenDenTemp Tree 3" sch 80*

$D_{i6temp} := 5.5\,in - 2\cdot\frac{7}{8}\cdot in$ New Temp. Tree 6"

$D_{itransfer11} := 9.75\,in$ New Transfer Pump 10" sch. 80 pipe

$D_{itransfer32} := 30.624\,in$ New Transfer Pump 32"

$D_{irdw} := 5.047\,in$ ID of Radiation Dry Wells

$D_{iMIT} := 3.5\,in - 2\cdot .188\,in$ IDof MIT's

$D_{itransfer4} := 4.026\,in$ ID of SY 102 Riser 23 Transfer Pump

Wall thickness of components:

$t_{wtemp} := .375\,in$ Wall thickness of temperature tree

$t_{wtherm} := 0.113\,in$ Wall thickness of thermowell

$t_{wdrain} := .216\,in$ Wall thickness of sluice pit drain

$t_{walc} := .312\,in$ Wall thickness of ALC

$t_{LDPD} := .237\,in$ Wall thickness leak detection pit drain

$t_{sludge} := .113\,in$ Wall thickness Sludge Temperature

$t_{profile} := .216\,in$ Wall thickness Profile Temperature

$t_{VDDT} := .3\cdot in$ VD Temp Tree Sch 80 wall thickness

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$t_{6temp} := \frac{7}{8} \cdot in$ New 6" temp tree wall thickness

$t_{transfer11} := .5 \cdot in$ New Transfer Pump 10" sch. 80 pipe for 11" pump

$t_{transfer32} := .668 in$ New Transfer Pump 32"

$t_{rdw} := .258 in$ Wall thickness of RDW

$t_{mit} := .188 in$ Wall thickness of MIT

$t_{transfer4} := .237 \cdot in$ Wall thickness of SY 102 Riser 23 transfer pump

Outer diameters of components:

$D_{otemp} := D_{itemp} + 2 \cdot t_{wtemp}$ Outer diameter of temperature tree

$D_{odrain} := 3.5 in$ Outer diameter of sluice pit drain

$D_{otherm} := D_{ithermowell} + 2 \cdot t_{wtherm}$ *Outer diameter of thermowells*

$D_{oalc} := D_{ialc} + 2 \cdot t_{walc}$ Outer diameter of ALC

$D_{oLDPD} := D_{iLDPD} + 2 \cdot t_{LDPD}$ Outer diameter of leak detection pit drain

$D_{osludge} := D_{isludge} + 2 \cdot t_{sludge}$ Outer diameter of sludge temperature tree

$D_{oprofile} := D_{iprofile} + 2 \cdot t_{profile}$ Outer diameter of profile temperature tree

$D_{oVDDT} := D_{iVDTT} + 2 \cdot t_{VDDT}$ *Outer diamter of Vel Den Temp. Tree*

$D_{o6temp} := 5.5 in$ Outer diameter of New 6" Temp. Tree

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$D_{otransfer11} := D_{itransfer11} + 2 \cdot t_{transfer11}$ Outer diameter New Transfer Pump 10" sch 8(

$D_{otransfer32} := D_{itransfer32} + 2 \cdot t_{transfer32}$ Outer diameter New Transfer Pump 32

$D_{ordw} := D_{irdw} + 2 \cdot t_{rdw}$ OD of RDW

$D_{omit} := 3.5 \cdot in$ Outer diamter of MIT

$D_{otransfer4} := 4.5 \cdot in$ OD of SY 102 Riser 23 Transfer Pump

Moment of Inertia for components:

$I_{pipe} := \frac{\pi}{64}\left(D_{otemp}{}^4 - D_{itemp}{}^4\right)$ Moment of inertia of temperature tree

$I_{drain} := \frac{\pi}{64} \cdot \left(D_{odrain}{}^4 - D_{idrain}{}^4\right)$ Moment of inertia for sluice pit drain

$I_{therm} := \frac{\pi}{64} \cdot \left(D_{otherm}{}^4 - D_{ithermowell}{}^4\right)$ Moment of inertia for thermowells

$I_{alc} := \frac{\pi}{64} \cdot \left(D_{oalc}{}^4 - D_{ialc}{}^4\right)$ Moment of inertia for ALC

$I_{LDPD} := \frac{\pi}{64} \cdot \left(D_{oLDPD}{}^4 - D_{iLDPD}{}^4\right)$ Moment of inertia for Leak Detection Pit Drain

$I_{profile} := \frac{\pi}{64} \cdot \left(D_{oprofile}{}^4 - D_{iprofile}{}^4\right)$ Moment of inertia for Profile Thermocouple

$I_{sludge} := \frac{\pi}{64} \cdot \left(D_{osludge}{}^4 - D_{isludge}{}^4\right)$ Moment of inertia for Sludge Thermocouple

$I_{VDTT} := \frac{\pi}{64} \cdot \left(D_{oVDDT}{}^4 - D_{iVDTT}{}^4\right)$ Moment of inertia for Vel Den Temp Tree

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$I_{6temp} := \frac{\pi}{64}\cdot\left(D_{o6temp}{}^{4} - D_{i6temp}{}^{4}\right)$ Moment of inertia for New 6" Temp Tree

$I_{transfer11} := \frac{\pi}{64}\cdot\left(D_{otransfer11}{}^{4} - D_{itransfer11}{}^{4}\right)$ Moment of inertia for New 11" transfer pump

$I_{transfer32} := \frac{\pi}{64}\cdot\left(D_{otransfer32}{}^{4} - D_{itransfer32}{}^{4}\right)$ Moment of inertia for New 32" transfer pump

$I_{rdw} := \frac{\pi}{64}\cdot\left(D_{ordw}{}^{4} - D_{irdw}{}^{4}\right)$ Moment of inertia for RDW

$I_{mit} := \frac{\pi}{64}\cdot\left(D_{omit}{}^{4} - D_{iMIT}{}^{4}\right)$ Moment of inertia for MIT

$I_{transfer4} := \frac{\pi}{64}\cdot\left(D_{otransfer4}{}^{4} - D_{itransfer4}{}^{4}\right)$ Moment of inertia for SY 102 Riser 23 Transfer Pum|

Section modulus for components:

$c := \frac{1}{2}\cdot D_{o6temp}$ $\quad c_{drain} := \frac{1}{2}\cdot D_{odrain}$ $\quad c_{therm} := \frac{1}{2}\cdot D_{otherm}$ $\quad c_{alc} := \frac{1}{2}\cdot D_{oalc}$

$c_{vdtt} := \frac{1}{2}\cdot D_{oVDDT}$ $\quad c_{transfer11} := \frac{D_{otransfer11}}{2}$ $\quad c_{transfer32} := \frac{D_{otransfer32}}{2}$

$c_{transfer4} := \frac{D_{otransfer4}}{2}$ $\quad c_{profile} := \frac{D_{oprofile}}{2}$ $\quad c_{rdw} := \frac{D_{ordw}}{2}$ $\quad c_{mit} := \frac{D_{omit}}{2}$

$c_{LDPD} := \frac{D_{oLDPD}}{2}$

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$S_{6temp} := \frac{I_{6temp}}{c}$ Section modulus of temperature tree

$S_{drain} := \frac{I_{drain}}{c_{drain}}$ Section modulus of sluice pit drain

$S_{alc} := \frac{I_{alc}}{c_{alc}}$ Section modulus of ALC

$S_{therm} := \frac{I_{therm}}{c_{therm}}$ Section modulus of thermowell

$S_{VDTT} := \frac{I_{VDTT}}{c_{vdtt}}$ Section modulus of Vel Den Temp Tree

$S_{transfer11} := \frac{I_{transfer11}}{c_{transfer11}}$ Section moduls of 11" New transfer Pump

$S_{transfer32} := \frac{I_{transfer32}}{c_{transfer32}}$ Section moduls of 32" New transfer Pump

$S_{transfer4} := \frac{I_{transfer4}}{c_{transfer4}}$ Section moduls of 4" Transfer Pump

$S_{profile} := \frac{I_{profile}}{c_{profile}}$ Section modulus of Profile Probe

$S_{rdw} := \frac{I_{rdw}}{c_{rdw}}$ Section modulus of RDW

$S_{mit} := \frac{I_{mit}}{c_{mit}}$ Section moduls of MIT

$S_{LDPD} := \frac{I_{LDPD}}{c_{LDPD}}$ Section modulus of Leak Detection Pit Drain

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Cross sectional area of components:

$A_{6temp} := \frac{\pi}{4}\cdot\left(D_{o6temp}^{\;2} - D_{i6temp}^{\;2}\right)$ Cross-sectional area of temperature tree

$A_{drain} := \frac{\pi}{4}\cdot\left(D_{odrain}^{\;2} - D_{idrain}^{\;2}\right)$ Cross-sectional area of sluice pit drain

$A_{therm} := \frac{\pi}{4}\cdot\left(D_{otherm}^{\;2} - D_{ithermowell}^{\;2}\right)$ Cross-sectional area of thermowell

$A_{alc} := \frac{\pi}{4}\cdot\left(D_{oalc}^{\;2} - D_{ialc}^{\;2}\right)$ Cross-sectional area of ALC

$A_{vdtt} := \frac{\pi}{4}\cdot\left(D_{oVDDT}^{\;2} - D_{iVDTT}^{\;2}\right)$ Cross sectional area of VDTT

$A_{transfer11} := \frac{\pi}{4}\cdot\left(D_{otransfer11}^{\;2} - D_{itransfer11}^{\;2}\right)$ Cross sectional area of 11" Transfer Pump

$A_{transfer32} := \frac{\pi}{4}\cdot\left(D_{otransfer32}^{\;2} - D_{itransfer32}^{\;2}\right)$ Cross sectional area of 32" Transfer Pump

$A_{transfer4} := \frac{\pi}{4}\cdot\left(D_{otransfer4}^{\;2} - D_{itransfer4}^{\;2}\right)$ Cross sectional area of 4" Transfer Pump

$A_{profile} := \frac{\pi}{4}\cdot\left(D_{oprofile}^{\;2} - D_{iprofile}^{\;2}\right)$ Cross sectional area of Profile Probe

$A_{rdw} := \frac{\pi}{4}\cdot\left(D_{ordw}^{\;2} - D_{irdw}^{\;2}\right)$ Cross sectional area of RDW

$A_{mit} := \frac{\pi}{4}\cdot\left(D_{omit}^{\;2} - D_{iMIT}^{\;2}\right)$ Cross sectional area of MIT

$A_{ldpd} := \frac{\pi}{4}\cdot\left(D_{oLDPD}^{\;2} - D_{iLDPD}^{\;2}\right)$ Cross sectional area of Leak Detection Pit Drain

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Limit load shape factor (Julyk 1997) for components:

$$K_{ldrain} := \frac{16}{3\cdot\pi}\cdot D_{odrain}\cdot\frac{\left(D_{odrain}^{3} - D_{idrain}^{3}\right)}{D_{odrain}^{4} - D_{idrain}^{4}}$$

Limit load shape factor for sluice pit drain

$$K_{ltherm} := \frac{16}{3\cdot\pi}\cdot D_{otherm}\cdot\frac{\left(D_{otherm}^{3} - D_{ithermowell}^{3}\right)}{D_{otherm}^{4} - D_{ithermowell}^{4}}$$

Limit load shape factor for thermowells

$$K_{ltemp} := \frac{16}{3\cdot\pi}\cdot D_{otemp}\cdot\frac{\left(D_{otemp}^{3} - D_{itemp}^{3}\right)}{D_{otemp}^{4} - D_{itemp}^{4}}$$

Limit load shape factor for temperature tree

$$K_{lalc} := \frac{16}{3\cdot\pi}\cdot D_{oalc}\cdot\frac{\left(D_{oalc}^{3} - D_{ialc}^{3}\right)}{D_{oalc}^{4} - D_{ialc}^{4}}$$

Limit load shape factor for ALC

$$K_{lldpd} := \frac{16}{3\cdot\pi}\cdot D_{oLDPD}\cdot\frac{\left(D_{oLDPD}^{3} - D_{iLDPD}^{3}\right)}{D_{oLDPD}^{4} - D_{iLDPD}^{4}}$$

Limit load shape factor for Leak Detection Pit Drain

$$K_{lprofile} := \frac{16}{3\cdot\pi}\cdot D_{oprofile}\cdot\frac{\left(D_{oprofile}^{3} - D_{iprofile}^{3}\right)}{D_{oprofile}^{4} - D_{iprofile}^{4}}$$

Limit load shape factor for Profile Thermocouple

$$K_{lsludge} := \frac{16}{3\cdot\pi}\cdot D_{osludge}\cdot\frac{\left(D_{osludge}^{3} - D_{isludge}^{3}\right)}{D_{osludge}^{4} - D_{isludge}^{4}}$$

Limit load shape factor for Sludge Thermocouple

$$K_{lVDTT} := \frac{16}{3\cdot\pi}\cdot D_{oVDDT}\cdot\frac{\left(D_{oVDDT}^{3} - D_{iVDTT}^{3}\right)}{D_{oVDDT}^{4} - D_{iVDTT}^{4}}$$

Limit load shape factor for Vel Den Temp Tree

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$$K_{l6temp} := \frac{16}{3\cdot\pi}\cdot D_{o6temp}\cdot\frac{\left(D_{o6temp}^{\ 3} - D_{i6temp}^{\ 3}\right)}{D_{o6temp}^{\ 4} - D_{i6temp}^{\ 4}}$$ Limit load shape factor for New 6" Temp Tree

Limit load shape factor for New 11" Transfer pump

$$K_{ltransfer11} := \frac{16}{3\cdot\pi}\cdot D_{otransfer11}\cdot\frac{\left(D_{otransfer11}^{\ 3} - D_{itransfer11}^{\ 3}\right)}{D_{otransfer11}^{\ 4} - D_{itransfer11}^{\ 4}}$$

Limit load shape factor for New 32" Transfer pump

$$K_{ltransfer32} := \frac{16}{3\cdot\pi}\cdot D_{otransfer32}\cdot\frac{\left(D_{otransfer32}^{\ 3} - D_{itransfer32}^{\ 3}\right)}{D_{otransfer32}^{\ 4} - D_{itransfer32}^{\ 4}}$$

$$K_{lrdw} := \frac{16}{3\cdot\pi}\cdot D_{ordw}\cdot\frac{\left(D_{ordw}^{\ 3} - D_{irdw}^{\ 3}\right)}{D_{ordw}^{\ 4} - D_{irdw}^{\ 4}}$$ Limit load shape factor for RDW

$$K_{lmit} := \frac{16}{3\cdot\pi}\cdot D_{omit}\cdot\frac{\left(D_{omit}^{\ 3} - D_{iMIT}^{\ 3}\right)}{D_{omit}^{\ 4} - D_{iMIT}^{\ 4}}$$ Limit load shape factor for MIT

$$K_{ltransfer4} := \frac{16}{3\cdot\pi}\cdot D_{otransfer4}\cdot\frac{\left(D_{otransfer4}^{\ 3} - D_{itransfer4}^{\ 3}\right)}{D_{otransfer4}^{\ 4} - D_{itransfer4}^{\ 4}}$$ Limit load shape factor for SY 10~~1~~ 2 DCC 9/27/00
Riser 23 Transfer Pump

Maximum forces for components from Section 1 at 70% Speed:

$P_{alc} := 170\,lbf$ $\quad P_{alc3} := 101\cdot lbf$ $\quad P_{drain} := 81\cdot lbf$

$P_{alc2} := 167\cdot lbf$ $\quad P_{alc4} := 97\cdot lbf$ $\quad P_{temp} := 45\cdot lbf$

$P_{therm} := 49\cdot lbf$ $\quad P_{therm3} := 41\cdot lbf$

$P_{therm2} := 48\cdot lbf$ $\quad P_{therm4} := 40\cdot lbf$ $\quad P_{tempsludge} := 48\cdot lbf$

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Lengths of moment arms for components:

$L_{therm} := 27 \cdot in$ Moment arm of thermowell assumed at end of ALC where supported.

$L_r := 52 \cdot in + 167 \cdot in$ Length of riser for leak detection pit drain pipe.

$L_{drain} := 39 \cdot ft$ Length of sluice pit drain pipe.

$L_{udrain} := L_{drain}$ Moment arm of sluice pit drain

$L_{temp} := 56.8 ft$

$L_{utemp} := L_{temp}$ Assume momemt arm of temperature tree is length of tree

$L_{alc} := 52 \cdot ft$ Conservative longest length ALC

$L_{LDPD} := 34 \cdot ft + 8 \cdot \frac{3}{4} \cdot in$ Length of leak detection pit drain

$L_{uldpd} := L_{LDPD} + L_r$ Length of moment arm for leak detection pit drain

$L_{profile} := 50 \cdot ft + 7 \cdot \frac{3}{4} \cdot in$ Length of 1 of the 3/4" profile legs

$L_{sludge} := 50 \cdot ft + 7 \cdot \frac{3}{4} \cdot in$ Length of sludge leg without stiffener

$L_{VDTT} := 53.6 ft$ Length of Vel Den Temp. Tree

$L_{mit} := 54.8 ft$ Total Length of MIT

$L_{transfer4} := 45 \cdot ft$ Moment arm of SY 10~~1~~ 2 Riser 23 Transfer Pump

MV 9/27/00

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Locations of deflection evaluation from end of component:

$z_{therm} := 0 \cdot in$ $\quad z_{drain} := 0 \cdot in$ $\quad z_{temp} := 0in$ $\quad z_{alc} := 0 \cdot in$

$z_{LDPD} := 0in$ $\quad z_{sludge} := 0 \cdot in$ $\quad z_{profile} := 0 \cdot in$ $\quad z_{VDTT} := 0 \cdot in$

Determine deflection of components from maximum forces at 70 % speed.

Deflection formula from Roarke 1965 assuming constant structural cross-sectional properties foi cantilever beam with lateral end load.

AY TANK THERMOWELLS

$$u_{therm} := \frac{1}{6} \cdot \frac{P_{therm}}{E \cdot I_{therm}} \cdot \left(z_{therm}{}^{3} - 3 \cdot L_{therm}{}^{2} z_{therm} + 2 \cdot L_{therm}{}^{3} \right) \qquad u_{therm} = 0.299in$$

$$u_{therm2} := \frac{1}{6} \cdot \frac{P_{therm2}}{E \cdot I_{therm}} \cdot \left(z_{therm}{}^{3} - 3 \cdot L_{therm}{}^{2} z_{therm} + 2 \cdot L_{therm}{}^{3} \right) \qquad u_{therm2} = 0.293in$$

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$$u_{therm3} := \frac{1}{6}\cdot\frac{P_{therm3}}{E\cdot I_{therm}}\cdot\left(z_{therm}^{3} - 3\cdot L_{therm}^{2} z_{therm} + 2\cdot L_{therm}^{3}\right) \qquad u_{therm3} = 0.25\text{in}$$

$$u_{therm4} := \frac{1}{6}\cdot\frac{P_{therm4}}{E\cdot I_{therm}}\cdot\left(z_{therm}^{3} - 3\cdot L_{therm}^{2} z_{therm} + 2\cdot L_{therm}^{3}\right) \qquad u_{therm4} = 0.244\text{in}$$

AY TANKS ALCs

$$u_{alc} := \frac{1}{6}\cdot\frac{P_{alc}}{E\cdot I_{alc}}\cdot\left(z_{alc}^{3} - 3\cdot L_{alc}^{2} z_{alc} + 2\cdot L_{alc}^{3}\right) \qquad u_{alc} = 0.508\text{in}$$

$$u_{alc2} := \frac{1}{6}\cdot\frac{P_{alc2}}{E\cdot I_{alc}}\cdot\left(z_{alc}^{3} - 3\cdot L_{alc}^{2} z_{alc} + 2\cdot L_{alc}^{3}\right) \qquad u_{alc2} = 0.499\text{in}$$

$$u_{alc3} := \frac{1}{6}\cdot\frac{P_{alc3}}{E\cdot I_{alc}}\cdot\left(z_{alc}^{3} - 3\cdot L_{alc}^{2} z_{alc} + 2\cdot L_{alc}^{3}\right) \qquad u_{alc3} = 0.302\text{in}$$

$$u_{alc4} := \frac{1}{6}\cdot\frac{P_{alc4}}{E\cdot I_{alc}}\cdot\left(z_{alc}^{3} - 3\cdot L_{alc}^{2} z_{alc} + 2\cdot L_{alc}^{3}\right) \qquad u_{alc4} = 0.29\text{in}$$

SLUICE PIT DRAIN

$$Pl_{drain} := 81\cdot\text{lbf}$$

$$u_{drain} := \frac{1}{6}\cdot\frac{Pl_{drain}}{E\cdot I_{drain}}\cdot\left(z_{drain}^{3} - 3\cdot L_{udrain}^{2} z_{drain} + 2\cdot L_{udrain}^{3}\right) \qquad u_{drain} = 31.63\text{in}$$

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AY TANKS LEAK DETECTION PIT DRAIN

$$P1_{LDPD} := 43.5\,lbf$$

$$u_{LDPD} := \frac{1}{6}\cdot\frac{P1_{LDPD}}{E\cdot I_{LDPD}}\cdot\left(z_{LDPD}^{3} - 3\cdot L_{LDPD}^{2}z_{LDPD} + 2\cdot L_{LDPD}^{3}\right) \qquad u_{LDPD} = 4.905in$$

$$P2_{LDPD} := 45.7\cdot lbf$$

$$u2_{LDPD} := \frac{1}{6}\cdot\frac{P2_{LDPD}}{E\cdot I_{LDPD}}\cdot\left(z_{LDPD}^{3} - 3\cdot L_{LDPD}^{2}z_{LDPD} + 2\cdot L_{LDPD}^{3}\right) \qquad u2_{LDPD} = 5.154in$$

SY TANKS VEL DEN TEMP TREES

Riser 3, Mixer #1	$P1_{3VDTT} := 47.8\,lbf$	**Riser 3, Mixer #2**	$P2_{3VDTT} := 41.8\,lbf$
Riser 15, Mixer #1	$P1_{15VDTT} := 45.8\,lbf$	**Riser 15, Mixer #2**	$P2_{15VDTT} := 40.8\,lbf$

$$u1_{3VDTT} := \frac{1}{6}\cdot\frac{P1_{3VDTT}}{E\cdot I_{VDTT}}\cdot\left(z_{VDTT}^{3} - 3\cdot L_{VDTT}^{2}z_{VDTT} + 2\cdot L_{VDTT}^{3}\right) \qquad u1_{3VDTT} = 37.542in$$

$$u2_{3VDTT} := \frac{1}{6}\cdot\frac{P2_{3VDTT}}{E\cdot I_{VDTT}}\cdot\left(z_{VDTT}^{3} - 3\cdot L_{VDTT}^{2}z_{VDTT} + 2\cdot L_{VDTT}^{3}\right) \qquad u2_{3VDTT} = 32.829in$$

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NEW 6" TEMP. TREES

AW TANKS

$P1_{aw6temp} := 40.7 \cdot lbf$ $\quad L_{6temp} := 52 \cdot ft$ **Moment Arm**~~(52 ft minus 10 ft riser)~~ MCC 9/27/00

$P2_{aw6temp} := 42.1 \cdot lbf$ $\quad z_{6temp} := 0 \cdot in$ **Location of Analysis**

$$u1_{aw6temp} := \frac{1}{6} \cdot \frac{P1_{aw6temp}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot L_{6temp}{}^{2} z_{6temp} + 2 \cdot L_{6temp}{}^{3} \right) \qquad u1_{aw6temp} = 3.228in$$

$$u2_{aw6temp} := \frac{1}{6} \cdot \frac{P2_{aw6temp}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot L_{6temp}{}^{2} z_{6temp} + 2 \cdot L_{6temp}{}^{3} \right) \qquad u2_{aw6temp} = 3.339in$$

SY TANKS

$P1_{sy6temp} := 40.8 lbf$ $\quad L_{6temp} := 52 \cdot ft$

$P2_{sy6temp} := 42.9 lbf$ $\quad z_{6temp} := 0 \cdot in$ **Location of Analysis**

$$u1_{sy6temp} := \frac{1}{6} \cdot \frac{P1_{sy6temp}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot L_{6temp}{}^{2} z_{6temp} + 2 \cdot L_{6temp}{}^{3} \right) \qquad u1_{sy6temp} = 3.236in$$

$$u2_{sy6temp} := \frac{1}{6} \cdot \frac{P2_{sy6temp}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot L_{6temp}{}^{2} z_{6temp} + 2 \cdot L_{6temp}{}^{3} \right) \qquad u2_{sy6temp} = 3.403in$$

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AY TANKS

$P1_{15day6temp} := 45\cdot lbf$ $P2_{15day6temp} := 41.3\cdot lbf$ $L_{6temp} := 52\cdot ft$ Moment Arm

$P1_{15hay6temp} := 48\cdot lbf$ $P2_{15hay6temp} := 48\cdot lbf$ $z_{6temp} := 0\cdot in$ Location of Analysis

$P1_{15lay6temp} := 41.4\cdot lbf$ $P2_{15lay6temp} := 45\cdot lbf$

$P1_{15pay6temp} := 48\cdot lbf$ $P2_{15pay6temp} := 48\cdot lbf$

$P1_{15aay6temp} := 41\cdot lbf$ $P2_{15aay6temp} := 47\cdot lbf$

$$u1_{15aay6temp} := \frac{1}{6}\cdot\frac{P1_{15aay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{3} - 3\cdot L_{6temp}^{2} z_{6temp} + 2\cdot L_{6temp}^{3}\right) \qquad u1_{15aay6temp} = 3.252in$$

$$u2_{15aay6temp} := \frac{1}{6}\cdot\frac{P2_{15aay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{3} - 3\cdot L_{6temp}^{2} z_{6temp} + 2\cdot L_{6temp}^{3}\right) \qquad u2_{15aay6temp} = 3.728in$$

$$u1_{15day6temp} := \frac{1}{6}\cdot\frac{P1_{15day6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{3} - 3\cdot L_{6temp}^{2} z_{6temp} + 2\cdot L_{6temp}^{3}\right) \qquad u1_{15day6temp} = 3.569in$$

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$$u2_{15day6temp} := \frac{1}{6}\cdot\frac{P2_{15day6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}{}^{3} - 3\cdot L_{6temp}{}^{2} z_{6temp} + 2\cdot L_{6temp}{}^{3}\right) \qquad u2_{15day6temp} = 3.276\text{in}$$

$$u1_{15hay6temp} := \frac{1}{6}\cdot\frac{P1_{15hay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}{}^{3} - 3\cdot L_{6temp}{}^{2} z_{6temp} + 2\cdot L_{6temp}{}^{3}\right) \qquad u1_{15hay6temp} = 3.807\text{in}$$

$$u2_{15hay6temp} := \frac{1}{6}\cdot\frac{P2_{15hay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}{}^{3} - 3\cdot L_{6temp}{}^{2} z_{6temp} + 2\cdot L_{6temp}{}^{3}\right) \qquad u2_{15hay6temp} = 3.807\text{in}$$

$$u1_{15lay6temp} := \frac{1}{6}\cdot\frac{P1_{15lay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}{}^{3} - 3\cdot L_{6temp}{}^{2} z_{6temp} + 2\cdot L_{6temp}{}^{3}\right) \qquad u1_{15lay6temp} = 3.284\text{in}$$

$$u2_{15lay6temp} := \frac{1}{6}\cdot\frac{P2_{15lay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}{}^{3} - 3\cdot L_{6temp}{}^{2} z_{6temp} + 2\cdot L_{6temp}{}^{3}\right) \qquad u2_{15lay6temp} = 3.569\text{in}$$

$$u1_{15pay6temp} := \frac{1}{6}\cdot\frac{P1_{15pay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}{}^{3} - 3\cdot L_{6temp}{}^{2} z_{6temp} + 2\cdot L_{6temp}{}^{3}\right) \qquad u1_{15pay6temp} = 3.807\text{in}$$

$$u2_{15pay6temp} := \frac{1}{6}\cdot\frac{P2_{15pay6temp}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}{}^{3} - 3\cdot L_{6temp}{}^{2} z_{6temp} + 2\cdot L_{6temp}{}^{3}\right) \qquad u2_{15pay6temp} = 3.807\text{in}$$

NEW 11" TRANSFER PUMPS

AW TANKS

$L_{transfer11} := 46\,\text{ft}$ **Moment Arm**

$P1_{awtransfer11} := 41.6\,\text{lbf}$

$z_{transfer} := 0\cdot\text{in}$ **Location of Analysis**

$P2_{awtransfer11} := 40.8\,\text{lbf}$

$$u1_{awtransfer11} := \frac{1}{6}\cdot\frac{P1_{awtransfer11}}{E\cdot I_{transfer11}}\cdot\left(z_{transfer}{}^{3} - 3\cdot L_{transfer11}{}^{2} z_{transfer} + 2\cdot L_{transfer11}{}^{3}\right)$$

$$u1_{awtransfer11} = 0.379\text{in}$$

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$$u2_{awtransfer11} := \frac{1}{6}\cdot\frac{P2_{awtransfer11}}{E\cdot I_{transfer11}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transfer11}^{2} z_{transfer} + 2\cdot L_{transfer11}^{3}\right)$$

$$u2_{awtransfer11} = 0.372\text{in}$$

SY TANKS

$L_{transferSY11} := 47\cdot ft$ Moment Arm

$P1_{sytransfer11} := 49.3\,lbf$

$z_{transfer} := 0\cdot in$ Location of Analysis

$P2_{sytransfer11} := 61.5\,lbf$

$$u1_{sytransfer11} := \frac{1}{6}\cdot\frac{P1_{sytransfer11}}{E\cdot I_{transfer11}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transferSY11}^{2} z_{transfer} + 2\cdot L_{transferSY11}^{3}\right)$$

$$u1_{sytransfer11} = 0.48\text{in}$$

$$u2_{sytransfer11} := \frac{1}{6}\cdot\frac{P2_{sytransfer11}}{E\cdot I_{transfer11}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transferSY11}^{2} z_{transfer} + 2\cdot L_{transferSY11}^{3}\right)$$

$$u2_{sytransfer11} = 0.598\text{in}$$

AY TANKS

$L_{transfer11} := 46\,ft + 1\cdot in$ Moment Arm

$P1_{aytransfer11} := 40.8\,lbf$

$z_{transfer} := 0\cdot in$ Location of Analysis

$$u1_{aytransfer11} := \frac{1}{6}\cdot\frac{P1_{aytransfer11}}{E\cdot I_{transfer11}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transfer11}^{2} z_{transfer} + 2\cdot L_{transfer11}^{3}\right)$$

$$u1_{aytransfer11} = 0.374\text{in}$$

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NEW 32" TRANSFER PUMP

AW TANKS

$L_{transfer32} := 46\cdot ft$ Moment Arm

$P1_{awtransfer32} := 59.4\,lbf$

$z_{transfer} := 0\cdot in$ Location of Analysis

$P2_{awtransfer32} := 49.3\,lbf$

$$u1_{awtransfer32} := \frac{1}{6}\cdot\frac{P1_{awtransfer32}}{E\cdot I_{transfer32}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transfer32}^{2}z_{transfer} + 2\cdot L_{transfer32}^{3}\right)$$

$u1_{awtransfer32} = 0.014in$

$$u2_{awtransfer32} := \frac{1}{6}\cdot\frac{P2_{awtransfer32}}{E\cdot I_{transfer32}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transfer32}^{2}z_{transfer} + 2\cdot L_{transfer32}^{3}\right)$$

$u2_{awtransfer32} = 0.012in$

SY TANKS

$L_{transferSY11} := 47\cdot ft$ Moment Arm

$P1_{sytransfer32} := 40.8\,lbf$

$z_{transfer} := 0\cdot in$ Location of Analysis

$P2_{sytransfer32} := 41.6\,lbf$

$$u1_{sytransfer32} := \frac{1}{6}\cdot\frac{P1_{sytransfer32}}{E\cdot I_{transfer11}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transferSY11}^{2}z_{transfer} + 2\cdot L_{transferSY11}^{3}\right)$$

$u1_{sytransfer32} = 0.397in$

$$u2_{sytransfer32} := \frac{1}{6}\cdot\frac{P2_{sytransfer32}}{E\cdot I_{transfer11}}\cdot\left(z_{transfer}^{3} - 3\cdot L_{transferSY11}^{2}z_{transfer} + 2\cdot L_{transferSY11}^{3}\right)$$

$u2_{sytransfer32} = 0.405in$

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AY TANKS

$L_{transfer11} := 46\,ft + 1\cdot in$ Moment Arm

$P1_{aytransfer32} := 49.5\,lbf$

$z_{transfer} := 0\cdot in$ Location of Analysis

$$u1_{aytransfer32} := \frac{1}{6}\cdot\frac{P1_{aytransfer32}}{E\cdot I_{transfer32}}\cdot\left(z_{transfer}{}^{3} - 3\cdot L_{transfer11}{}^{2}\, z_{transfer} + 2\cdot L_{transfer11}{}^{3}\right)$$

$u1_{aytransfer32} = 0.012in$

AY TANKS RADIATION DRY WELLS

$L_{rdw} := 45.7\cdot ft$ Moment Arm

$P1_{14ardw} := 47\cdot lbf$ $P2_{14ardw} := 41.4\,lbf$

$P1_{14brdw} := 41.4\,lbf$ $P2_{14brdw} := 47\cdot lbf$

$z_{rdw} := 0\cdot in$ Location of Analysis

$$u1_{14ardw} := \frac{1}{6}\cdot\frac{P1_{14ardw}}{E\cdot I_{rdw}}\cdot\left(z_{rdw}{}^{3} - 3\cdot L_{rdw}{}^{2}\, z_{rdw} + 2\cdot L_{rdw}{}^{3}\right)$$

$u1_{14ardw} = 5.876in$

$$u2_{14ardw} := \frac{1}{6}\cdot\frac{P2_{14ardw}}{E\cdot I_{rdw}}\cdot\left(z_{rdw}{}^{3} - 3\cdot L_{rdw}{}^{2}\, z_{rdw} + 2\cdot L_{rdw}{}^{3}\right)$$

$u2_{14ardw} = 5.176in$

$$u1_{14brdw} := \frac{1}{6}\cdot\frac{P1_{14brdw}}{E\cdot I_{rdw}}\cdot\left(z_{rdw}{}^{3} - 3\cdot L_{rdw}{}^{2}\, z_{rdw} + 2\cdot L_{rdw}{}^{3}\right)$$

$u1_{14brdw} = 5.176in$

$$u2_{14brdw} := \frac{1}{6}\cdot\frac{P2_{14brdw}}{E\cdot I_{rdw}}\cdot\left(z_{rdw}{}^{3} - 3\cdot L_{rdw}{}^{2}\, z_{rdw} + 2\cdot L_{rdw}{}^{3}\right)$$

$u2_{14brdw} = 5.876in$

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SY TANKS MULTI-FUNCTION INSTRUMENT TREE

$z_{MIT} := 0\cdot in$

Riser 18 SY-101 $\quad P1_{18mit} := 48\cdot lbf$ $\qquad$ Riser 18 Mixer #2 SY-101 $\quad P2_{18mit} := 48\cdot lbf$

Riser 19 SY -101 $\quad P1_{19mit} := 41\cdot lbf$ $\qquad$ Riser 19 Mixer #2 SY-101 $\quad P2_{19mit} := 44.9\cdot lbf$

$$u1_{18mit} := \frac{1}{6}\cdot\frac{P1_{18mit}}{E\cdot I_{mit}}\cdot\left(z_{MIT}^{\ 3} - 3\cdot L_{mit}^{\ 2} z_{MIT} + 2\cdot L_{mit}^{\ 3}\right) \qquad u1_{18mit} = 58.307in$$

$$u1_{19mit} := \frac{1}{6}\cdot\frac{P1_{19mit}}{E\cdot I_{mit}}\cdot\left(z_{MIT}^{\ 3} - 3\cdot L_{mit}^{\ 2} z_{MIT} + 2\cdot L_{mit}^{\ 3}\right) \qquad u1_{19mit} = 49.804in$$

$$u2_{19mit} := \frac{1}{6}\cdot\frac{P2_{19mit}}{E\cdot I_{mit}}\cdot\left(z_{MIT}^{\ 3} - 3\cdot L_{mit}^{\ 2} z_{MIT} + 2\cdot L_{mit}^{\ 3}\right) \qquad u2_{19mit} = 54.541in$$

Determine deflection at end of riser $\qquad z_{mit} := 465.5\,in + 29\cdot in$

$$u1_{19mit} := \frac{1}{6}\cdot\frac{P1_{19mit}}{E\cdot I_{mit}}\cdot\left(z_{mit}^{\ 3} - 3\cdot L_{mit}^{\ 2} z_{mit} + 2\cdot L_{mit}^{\ 3}\right) \qquad u1_{19mit} = 4.216in$$

Determine deflection assuming moment arm is at bottom of riser $\qquad L_{MIT} := 465.5\,in + 29\cdot in$

$$u1_{18mit} := \frac{1}{6}\cdot\frac{P1_{18mit}}{E\cdot I_{mit}}\cdot\left(z_{MIT}^{\ 3} - 3\cdot L_{MIT}^{\ 2} z_{MIT} + 2\cdot L_{MIT}^{\ 3}\right) \qquad u1_{18mit} = 24.793in$$

$$u1_{19mit} := \frac{1}{6}\cdot\frac{P1_{19mit}}{E\cdot I_{mit}}\cdot\left(z_{MIT}^{\ 3} - 3\cdot L_{MIT}^{\ 2} z_{MIT} + 2\cdot L_{MIT}^{\ 3}\right) \qquad u1_{19mit} = 21.178in$$

$$u2_{19mit} := \frac{1}{6}\cdot\frac{P2_{19mit}}{E\cdot I_{mit}}\cdot\left(z_{MIT}^{\ 3} - 3\cdot L_{MIT}^{\ 2} z_{MIT} + 2\cdot L_{MIT}^{\ 3}\right) \qquad u2_{19mit} = 23.192in$$

Determine deflection of components from maximum forces at 100% speed.

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Maximum forces for components at 100% speed from Section 1

$P_{alc100} := 609\,lbf$ $\quad P_{alc300} := 352\cdot lbf$ $\quad P_{drain100} := 276\,lbf$

$P_{alc200} := 609\,lbf$ $\quad P_{alc400} := 336\,lbf$ $\quad P_{temp100} := 87\cdot lbf$

$P_{therm100} := 148\,lbf$ $\quad P_{therm300} := 99\cdot lbf$

$P_{therm200} := 145\,lbf$ $\quad P_{therm400} := 96\,lbf$ $\quad P_{tempsludge100} := 141\cdot lbf$

AY TANKS THERMOWELLS

$$u_{therm100} := \frac{1}{6}\cdot\frac{P_{therm100}}{E\cdot I_{therm}}\cdot\left(z_{therm}{}^{3} - 3\cdot L_{therm}{}^{2} z_{therm} + 2\cdot L_{therm}{}^{3}\right) \qquad u_{therm100} = 0.904in$$

$$u_{therm200} := \frac{1}{6}\cdot\frac{P_{therm200}}{E\cdot I_{therm}}\cdot\left(z_{therm}{}^{3} - 3\cdot L_{therm}{}^{2} z_{therm} + 2\cdot L_{therm}{}^{3}\right) \qquad u_{therm200} = 0.886in$$

$$u_{therm300} := \frac{1}{6}\cdot\frac{P_{therm300}}{E\cdot I_{therm}}\cdot\left(z_{therm}{}^{3} - 3\cdot L_{therm}{}^{2} z_{therm} + 2\cdot L_{therm}{}^{3}\right) \qquad u_{therm300} = 0.605in$$

$$u_{therm400} := \frac{1}{6}\cdot\frac{P_{therm400}}{E\cdot I_{therm}}\cdot\left(z_{therm}{}^{3} - 3\cdot L_{therm}{}^{2} z_{therm} + 2\cdot L_{therm}{}^{3}\right) \qquad u_{therm400} = 0.586in$$

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AY TANKS ALCs

$$u_{alc100} := \frac{1}{6} \cdot \frac{P_{alc100}}{E \cdot I_{alc}} \cdot \left(z_{alc}^{3} - 3 \cdot L_{alc}^{2} z_{alc} + 2 \cdot L_{alc}^{3}\right) \qquad u_{alc100} = 1.819in$$

$$u_{alc200} := \frac{1}{6} \cdot \frac{P_{alc200}}{E \cdot I_{alc}} \cdot \left(z_{alc}^{3} - 3 \cdot L_{alc}^{2} z_{alc} + 2 \cdot L_{alc}^{3}\right) \qquad u_{alc200} = 1.819in$$

$$u_{alc300} := \frac{1}{6} \cdot \frac{P_{alc300}}{E \cdot I_{alc}} \cdot \left(z_{alc}^{3} - 3 \cdot L_{alc}^{2} z_{alc} + 2 \cdot L_{alc}^{3}\right) \qquad u_{alc300} = 1.051in$$

$$u_{alc400} := \frac{1}{6} \cdot \frac{P_{alc400}}{E \cdot I_{alc}} \cdot \left(z_{alc}^{3} - 3 \cdot L_{alc}^{2} z_{alc} + 2 \cdot L_{alc}^{3}\right) \qquad u_{alc400} = 1.003in$$

SLUICE PIT DRAIN

$$u_{drain100} := \frac{1}{6} \cdot \frac{P_{drain100}}{E \cdot I_{drain}} \cdot \left(z_{drain}^{3} - 3 \cdot L_{udrain}^{2} z_{drain} + 2 \cdot L_{udrain}^{3}\right) \qquad u_{drain100} = 107.778in$$

NEW 6" TEMP. TREES

AW Tanks

$P1_{aw6temp100} := 80.31 \cdot lbf$ $\quad L_{6temp} := 52 \cdot ft$ $\quad$ Moment Arm

$P2_{aw6temp100} := 88.7 \cdot lbf$ $\quad z_{6temp} := 0 \cdot in$ $\quad$ Location of Analysis

$$u1_{aw6temp100} := \frac{1}{6} \cdot \frac{P1_{aw6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}^{3} - 3 \cdot L_{6temp}^{2} z_{6temp} + 2 \cdot L_{6temp}^{3}\right) \qquad u1_{aw6temp100} = 6.37in$$

$$u2_{aw6temp100} := \frac{1}{6} \cdot \frac{P2_{aw6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}^{3} - 3 \cdot L_{6temp}^{2} z_{6temp} + 2 \cdot L_{6temp}^{3}\right) \qquad u2_{aw6temp100} = 7.035in$$

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SY Tanks

$P1_{sy6temp100} := 88.7 \cdot lbf$ $\quad L_{6temp} := 52 \cdot ft$ **Moment Arm**

$P2_{sy6temp100} := 80.3 \cdot lbf$ $\quad z_{6temp} := 0 \cdot in$ **Location of Analysis**

$$u1_{sy6temp100} := \frac{1}{6} \cdot \frac{P1_{sy6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}^{\ 3} - 3 \cdot L_{6temp}^{\ 2} z_{6temp} + 2 \cdot L_{6temp}^{\ 3} \right) \qquad u1_{sy6temp100} = 7.035 in$$

$$u2_{sy6temp100} := \frac{1}{6} \cdot \frac{P2_{sy6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}^{\ 3} - 3 \cdot L_{6temp}^{\ 2} z_{6temp} + 2 \cdot L_{6temp}^{\ 3} \right) \qquad u2_{sy6temp100} = 6.369 in$$

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AY Tanks

$P1_{15day6temp100} := 88 \cdot lbf$ $\quad P2_{15day6temp100} := 102.9 lbf$ $\quad Lay_{6temp} := 52 \cdot ft$ Moment Arm

$P1_{15hay6temp100} := 81 \cdot lbf$ $\quad P2_{15hay6temp100} := 81.6 lbf$ $\quad z_{6temp} := 0 \cdot in$ Location of Analysis

$P1_{15lay6temp100} := 103.5 lbf$ $\quad P2_{15lay6temp100} := 88 lbf$

$P1_{15pay6temp100} := 81.6 lbf$ $\quad P2_{15pay6temp100} := 81.1 \cdot lbf$

$P1_{15aay6temp100} := 98.9 lbf$ $\quad P2_{15aay6temp100} := 78.8 lbf$

$$u1_{15aay6temp100} := \frac{1}{6} \cdot \frac{P1_{15aay6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot L_{6temp}{}^{2} z_{6temp} + 2 \cdot L_{6temp}{}^{3} \right)$$

$$u1_{15aay6temp100} = 7.844 in$$

$$u2_{15aay6temp100} := \frac{1}{6} \cdot \frac{P2_{15aay6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot L_{6temp}{}^{2} z_{6temp} + 2 \cdot L_{6temp}{}^{3} \right)$$

$$u2_{15aay6temp100} = 6.25 in$$

$$u1_{15day6temp100} := \frac{1}{6} \cdot \frac{P1_{15day6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot Lay_{6temp}{}^{2} z_{6temp} + 2 \cdot Lay_{6temp}{}^{3} \right)$$

$$u1_{15day6temp100} = 6.98 in$$

$$u2_{15day6temp100} := \frac{1}{6} \cdot \frac{P2_{15day6temp100}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}{}^{3} - 3 \cdot L_{6temp}{}^{2} z_{6temp} + 2 \cdot L_{6temp}{}^{3} \right)$$

$$u2_{15day6temp100} = 8.162 in$$

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$$u1_{15hay6temp100} := \frac{1}{6}\cdot\frac{P1_{15hay6temp100}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{\ 3} - 3\cdot Lay_{6temp}^{\ 2}\cdot z_{6temp} + 2\cdot Lay_{6temp}^{\ 3}\right)$$

$$u1_{15hay6temp100} = 6.425in$$

$$u2_{15hay6temp100} := \frac{1}{6}\cdot\frac{P2_{15hay6temp100}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{\ 3} - 3\cdot L_{6temp}^{\ 2}\cdot z_{6temp} + 2\cdot L_{6temp}^{\ 3}\right)$$

$$u2_{15hay6temp100} = 6.472in$$

$$u1_{15lay6temp100} := \frac{1}{6}\cdot\frac{P1_{15lay6temp100}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{\ 3} - 3\cdot Lay_{6temp}^{\ 2}\cdot z_{6temp} + 2\cdot Lay_{6temp}^{\ 3}\right)$$

$$u1_{15lay6temp100} = 8.209in$$

$$u2_{15lay6temp100} := \frac{1}{6}\cdot\frac{P2_{15lay6temp100}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{\ 3} - 3\cdot L_{6temp}^{\ 2}\cdot z_{6temp} + 2\cdot L_{6temp}^{\ 3}\right)$$

$$u2_{15lay6temp100} = 6.98in$$

$$u1_{15pay6temp100} := \frac{1}{6}\cdot\frac{P1_{15pay6temp100}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{\ 3} - 3\cdot Lay_{6temp}^{\ 2}\cdot z_{6temp} + 2\cdot Lay_{6temp}^{\ 3}\right)$$

$$u1_{15pay6temp100} = 6.472in$$

$$u2_{15pay6temp100} := \frac{1}{6}\cdot\frac{P2_{15pay6temp100}}{E\cdot I_{6temp}}\cdot\left(z_{6temp}^{\ 3} - 3\cdot L_{6temp}^{\ 2}\cdot z_{6temp} + 2\cdot L_{6temp}^{\ 3}\right)$$

$$u2_{15pay6temp100} = 6.432in$$

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SY 102 RISER 23 TRANSFER PUMP

$z_{transfer4} := 0 \cdot in$

$P1_{transfer400} := 87.6\,lbf$ $\quad P2_{transfer400} := 102.5\,lbf$

$$u1_{transfer400} := \frac{1}{6} \cdot \frac{P1_{transfer400}}{E \cdot I_{transfer4}} \cdot \left(z_{transfer4}{}^{3} - 3 \cdot L_{transfer4}{}^{2} z_{transfer4} + 2 \cdot L_{transfer4}{}^{3}\right)$$

$u1_{transfer400} = 21.922in$

$$u2_{transfer400} := \frac{1}{6} \cdot \frac{P2_{transfer400}}{E \cdot I_{transfer4}} \cdot \left(z_{transfer4}{}^{3} - 3 \cdot L_{transfer4}{}^{2} z_{transfer4} + 2 \cdot L_{transfer4}{}^{3}\right)$$

$u2_{transfer400} = 25.65in$

NEW 11" TRANSFER PUMPS

AW Tanks

$L_{transfer11} := 46\,ft$ Moment Arm

$P1_{awtransfer1100} := 105.7\,lbf$

$z_{transfer} := 0 \cdot in$ Location of Analysis

$P2_{awtransfer1100} := 89.4\,lbf$

$$u1_{awtransfer1100} := \frac{1}{6} \cdot \frac{P1_{awtransfer1100}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}{}^{3} - 3 \cdot L_{transfer11}{}^{2} z_{transfer} + 2 \cdot L_{transfer11}{}^{3}\right)$$

$u1_{awtransfer1100} = 0.964in$

$$u2_{awtransfer1100} := \frac{1}{6} \cdot \frac{P2_{awtransfer1100}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}{}^{3} - 3 \cdot L_{transfer11}{}^{2} z_{transfer} + 2 \cdot L_{transfer11}{}^{3}\right)$$

$u2_{awtransfer1100} = 0.815in$

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SY TANKS

$L_{transferSY11} := 47 \cdot ft$ Moment Arm

$P1_{sytransfer1100} := 147.6 lbf$

$z_{transfer} := 0 \cdot in$ Location of Analysis

$P2_{sytransfer1100} := 199.9 lbf$

$$u1_{sytransfer1100} := \frac{1}{6} \cdot \frac{P1_{sytransfer1100}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}{}^{3} - 3 \cdot L_{transferSY11}{}^{2} z_{transfer} + 2 \cdot L_{transferSY11}{}^{3} \right)$$

$u1_{sytransfer1100} = 1.436 in$

$$u2_{sytransfer1100} := \frac{1}{6} \cdot \frac{P2_{sytransfer1100}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}{}^{3} - 3 \cdot L_{transferSY11}{}^{2} z_{transfer} + 2 \cdot L_{transferSY11}{}^{3} \right)$$

$u2_{sytransfer1100} = 1.945 in$

AY TANKS

$L_{transfer11} := 46 ft + 1 \cdot in$ Moment Arm

$P1_{aytransfer1100} := 89.8 lbf$

$z_{transfer} := 0 \cdot in$ Location of Analysis

$$u1_{aytransfer1100} := \frac{1}{6} \cdot \frac{P1_{aytransfer1100}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}{}^{3} - 3 \cdot L_{transfer11}{}^{2} z_{transfer} + 2 \cdot L_{transfer11}{}^{3} \right)$$

$u1_{aytransfer1100} = 0.824 in$

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SY 102 RISER 23 TRANSFER PUMP

$z_{transfer4} := 0 \cdot in$

$P1_{transfer400} := 87.6\,lbf \qquad P2_{transfer400} := 102.5\,lbf$

$$u1_{transfer400} := \frac{1}{6} \cdot \frac{P1_{transfer400}}{E \cdot I_{transfer4}} \cdot \left(z_{transfer4}^{\ 3} - 3 \cdot L_{transfer4}^{\ 2} z_{transfer4} + 2 \cdot L_{transfer4}^{\ 3} \right)$$

$u1_{transfer400} = 21.922in$

$$u2_{transfer400} := \frac{1}{6} \cdot \frac{P2_{transfer400}}{E \cdot I_{transfer4}} \cdot \left(z_{transfer4}^{\ 3} - 3 \cdot L_{transfer4}^{\ 2} z_{transfer4} + 2 \cdot L_{transfer4}^{\ 3} \right)$$

$u2_{transfer400} = 25.65in$

NEW 32" TRANSFER PUMP

AW Tanks

$L_{transfer32} := 46 \cdot ft$ **Moment Arm**

$P1_{awtransfer3200} := 191.5\,lbf$

$z_{transfer} := 0 \cdot in$ **Location of Analysis**

$P2_{awtransfer3200} := 147.6\,lbf$

$$u1_{awtransfer3200} := \frac{1}{6} \cdot \frac{P1_{awtransfer3200}}{E \cdot I_{transfer32}} \cdot \left(z_{transfer}^{\ 3} - 3 \cdot L_{transfer32}^{\ 2} z_{transfer} + 2 \cdot L_{transfer32}^{\ 3} \right)$$

$u1_{awtransfer3200} = 0.046in$

$$u2_{awtransfer3200} := \frac{1}{6} \cdot \frac{P2_{awtransfer3200}}{E \cdot I_{transfer32}} \cdot \left(z_{transfer}^{\ 3} - 3 \cdot L_{transfer32}^{\ 2} z_{transfer} + 2 \cdot L_{transfer32}^{\ 3} \right)$$

$u2_{awtransfer3200} = 0.035in$

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SY TANKS

$L_{transferSY11} := 47 \cdot ft$ Moment Arm

$P1_{sytransfer3200} := 89.4\,lbf$

$z_{transfer} := 0 \cdot in$ Location of Analysis

$P2_{sytransfer3200} := 105.7\,lbf$

$$u1_{sytransfer3200} := \frac{1}{6} \cdot \frac{P1_{sytransfer3200}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}{}^3 - 3 \cdot L_{transferSY11}{}^2 z_{transfer} + 2 \cdot L_{transferSY11}{}^3 \right)$$

$u1_{sytransfer3200} = 0.87in$

$$u2_{sytransfer3200} := \frac{1}{6} \cdot \frac{P2_{sytransfer3200}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}{}^3 - 3 \cdot L_{transferSY11}{}^2 z_{transfer} + 2 \cdot L_{transferSY11}{}^3 \right)$$

$u2_{sytransfer3200} = 1.028in$

AY TANKS

$L_{transfer11} := 46 \cdot ft + 1 \cdot in$ Moment Arm

$P1_{aytransfer3200} := 148.7\,lbf$

$z_{transfer} := 0 \cdot in$ Location of Analysis

$$u1_{aytransfer3200} := \frac{1}{6} \cdot \frac{P1_{aytransfer3200}}{E \cdot I_{transfer32}} \cdot \left(z_{transfer}{}^3 - 3 \cdot L_{transfer11}{}^2 z_{transfer} + 2 \cdot L_{transfer11}{}^3 \right)$$

$u1_{aytransfer3200} = 0.036in$

AY TANKS LEAK DETECTION PIT DRAIN $P1_{LDPD} := 88.6\,lbf$

$$u_{LDPD100} := \frac{1}{6} \cdot \frac{P1_{LDPD}}{E \cdot I_{LDPD}} \cdot \left(z_{LDPD}{}^3 - 3 \cdot L_{LDPD}{}^2 z_{LDPD} + 2 \cdot L_{LDPD}{}^3 \right) \qquad u_{LDPD100} = 9.991in$$

$P2_{LDPD} := 78.3\,lbf$

$$u2_{LDPD100} := \frac{1}{6} \cdot \frac{P2_{LDPD}}{E \cdot I_{LDPD}} \cdot \left(z_{LDPD}{}^3 - 3 \cdot L_{LDPD}{}^2 z_{LDPD} + 2 \cdot L_{LDPD}{}^3 \right) \qquad u2_{LDPD100} = 8.83in$$

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AY TANKS RADIATION DRY WELLS

$L_{Tdw} := 45.7 \cdot ft$ Moment Arm

$P1_{1400ardw} := 78.7 \cdot lbf$ $\quad P2_{1400ardw} := 103.5 lbf$

$P1_{1400brdw} := 103.5 lbf$ $\quad P2_{1400brdw} := 78.7 \cdot lbf$ $\quad z_{Tdw} := 0 \cdot in$ Location of Analysis

$$u1_{1400ardw} := \frac{1}{6} \cdot \frac{P1_{1400ardw}}{E \cdot I_{Tdw}} \cdot \left(z_{Tdw}^3 - 3 \cdot L_{Tdw}^2 z_{Tdw} + 2 \cdot L_{Tdw}^3\right) \qquad u1_{1400ardw} = 9.84 in$$

$$u2_{1400ardw} := \frac{1}{6} \cdot \frac{P2_{1400ardw}}{E \cdot I_{Tdw}} \cdot \left(z_{Tdw}^3 - 3 \cdot L_{Tdw}^2 z_{Tdw} + 2 \cdot L_{Tdw}^3\right) \qquad u2_{1400ardw} = 12.94 lin$$

$$u1_{1400brdw} := \frac{1}{6} \cdot \frac{P1_{1400brdw}}{E \cdot I_{Tdw}} \cdot \left(z_{Tdw}^3 - 3 \cdot L_{Tdw}^2 z_{Tdw} + 2 \cdot L_{Tdw}^3\right) \qquad u1_{1400brdw} = 12.94 lin$$

$$u2_{1400brdw} := \frac{1}{6} \cdot \frac{P2_{1400brdw}}{E \cdot I_{Tdw}} \cdot \left(z_{Tdw}^3 - 3 \cdot L_{Tdw}^2 z_{Tdw} + 2 \cdot L_{Tdw}^3\right) \qquad u2_{1400brdw} = 9.84 in$$

Determine deflection 30 ft from bottom of RDW

$z_{RDW} := 30 \cdot ft$

$$u2_{1400ardw} := \frac{1}{6} \cdot \frac{P2_{1400ardw}}{E \cdot I_{Tdw}} \cdot \left(z_{RDW}^3 - 3 \cdot L_{Tdw}^2 z_{RDW} + 2 \cdot L_{Tdw}^3\right) \qquad u2_{1400ardw} = 2.029 in$$

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</table>

SY TANKS MULTI-FUNCTION INSTRUMENT TREE

Riser 18 SY-101 $P1_{1800mit} := 81 \cdot lbf$ Riser 18 Mixer #2 SY-101 $P2_{1800mit} := 81 \cdot lbf$

Riser 19 SY -101 $P1_{1900mit} := 88.6 lbf$ Riser 19 Mixer #2 SY-101 $P2_{1900mit} := 87.1 \cdot lbf$

$$u1_{1800mit} := \frac{1}{6} \cdot \frac{P1_{1800mit}}{E \cdot I_{mit}} \cdot \left(z_{MIT}{}^3 - 3 \cdot L_{mit}{}^2 z_{MIT} + 2 \cdot L_{mit}{}^3 \right) \qquad u1_{1800mit} = 98.393in$$

$$u1_{1900mit} := \frac{1}{6} \cdot \frac{P1_{1900mit}}{E \cdot I_{mit}} \cdot \left(z_{MIT}{}^3 - 3 \cdot L_{mit}{}^2 z_{MIT} + 2 \cdot L_{mit}{}^3 \right) \qquad u1_{1900mit} = 107.625in$$

$$u2_{1900mit} := \frac{1}{6} \cdot \frac{P2_{1900mit}}{E \cdot I_{mit}} \cdot \left(z_{MIT}{}^3 - 3 \cdot L_{mit}{}^2 z_{MIT} + 2 \cdot L_{mit}{}^3 \right) \qquad u2_{1900mit} = 105.803in$$

Determine deflection at end of riser $z_{mit} := 465.5 in + 29 \cdot in$

$$u1_{1900mit} := \frac{1}{6} \cdot \frac{P1_{1900mit}}{E \cdot I_{mit}} \cdot \left(z_{mit}{}^3 - 3 \cdot L_{mit}{}^2 z_{mit} + 2 \cdot L_{mit}{}^3 \right) \qquad u1_{1900mit} = 9.11in$$

Determine deflection assuming moment arm is at bottom of riser $L_{MIT} := 465.5in + 29 \cdot in$

$$u1_{1800mit} := \frac{1}{6} \cdot \frac{P1_{1800mit}}{E \cdot I_{mit}} \cdot \left(z_{MIT}{}^3 - 3 \cdot L_{MIT}{}^2 z_{MIT} + 2 \cdot L_{MIT}{}^3 \right) \qquad u1_{1800mit} = 41.839in$$

$$u1_{1900mit} := \frac{1}{6} \cdot \frac{P1_{1900mit}}{E \cdot I_{mit}} \cdot \left(z_{MIT}{}^3 - 3 \cdot L_{MIT}{}^2 z_{MIT} + 2 \cdot L_{MIT}{}^3 \right) \qquad u1_{1900mit} = 45.764in$$

$$u2_{1900mit} := \frac{1}{6} \cdot \frac{P2_{1900mit}}{E \cdot I_{mit}} \cdot \left(z_{MIT}{}^3 - 3 \cdot L_{MIT}{}^2 z_{MIT} + 2 \cdot L_{MIT}{}^3 \right) \qquad u2_{1900mit} = 44.99in$$

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SY TANKS VEL DEN TEMP TREES

Riser 3, Mixer #1 $P1_{300VDTT} := 84.1 \cdot lbf$ Riser 3, Mixer #2 $P2_{300VDTT} := 104 lbf$

Riser 15, Mixer #1 $P1_{1500VDTT} := 88.2 \cdot lbf$ Riser 15, Mixer #2 $P2_{1500VDTT} := 86.8 lbf$

$$u1_{300VDTT} := \frac{1}{6} \cdot \frac{P1_{300VDTT}}{E \cdot I_{VDTT}} \cdot \left(z_{VDTT}^3 - 3 \cdot L_{VDTT}^2 z_{VDTT} + 2 \cdot L_{VDTT}^3 \right) \qquad u1_{300VDTT} = 66.052 in$$

$$u2_{300VDTT} := \frac{1}{6} \cdot \frac{P2_{300VDTT}}{E \cdot I_{VDTT}} \cdot \left(z_{VDTT}^3 - 3 \cdot L_{VDTT}^2 z_{VDTT} + 2 \cdot L_{VDTT}^3 \right) \qquad u2_{300VDTT} = 81.681 in$$

$$u1_{1500VDTT} := \frac{1}{6} \cdot \frac{P1_{1500VDTT}}{E \cdot I_{VDTT}} \cdot \left(z_{VDTT}^3 - 3 \cdot L_{VDTT}^2 z_{VDTT} + 2 \cdot L_{VDTT}^3 \right) \qquad u1_{1500VDTT} = 69.272 in$$

$$u2_{1500VDTT} := \frac{1}{6} \cdot \frac{P2_{1500VDTT}}{E \cdot I_{VDTT}} \cdot \left(z_{VDTT}^3 - 3 \cdot L_{VDTT}^2 z_{VDTT} + 2 \cdot L_{VDTT}^3 \right) \qquad u2_{1500VDTT} = 68.172 in$$

Determine deflection 40 ft from bottom of VDTT

$z_{vdtt} := 40 \cdot ft$

$$u2_{300VDTT} := \frac{1}{6} \cdot \frac{P2_{300VDTT}}{E \cdot I_{VDTT}} \cdot \left(z_{vdtt}^3 - 3 \cdot L_{VDTT}^2 z_{vdtt} + 2 \cdot L_{VDTT}^3 \right) \qquad u2_{300VDTT} = 7.221 in$$

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SECTION 3: ALLOWABLE YIELD FORCE FOR COMPONENTS

$W_{temp} := \delta \cdot L_{6temp} \cdot A_{6temp}$ Overall weight of temperature tree.

$W_{drain} := 7.6 \frac{lbf}{ft} \cdot L_{udrain}$ Overall weight of sluice pit drain

$W_{therm} := 1.13 \frac{lbf}{ft} \cdot (L_{therm} + 52 \cdot ft)$ Overall weight of entire thermowell

$W_{alc} := 99 \frac{lbf}{ft} \cdot (L_{alc})$ Overall weight of ALC

$W_{VDTT} := \delta \cdot (L_{VDTT}) \cdot A_{vdtt}$ Overall weight of VDTT

$W_{transfer11} := 55 \frac{lbf}{ft} \cdot (L_{transfer11})$ Overall weight of 11" Transfer Pump

$W_{transfer32} := 234 \frac{lbf}{ft} \cdot (L_{transfer11})$ Overall weight of 32" Transfer Pump

$W_{transfer4} := 11 \cdot \frac{lbf}{ft} \cdot (L_{transfer4})$ Overall weight of SY102 Riser 23 Transfer Pump

$W_{profile} := 11 \cdot \frac{lbf}{ft} \cdot (L_{profile})$ Overall weight of Profile Therm. Probe

$W_{rdw} := 16 \frac{lbf}{ft} \cdot (L_{rdw})$ Overall weight of RDW

$W_{mit} := 12 \cdot \frac{lbf}{ft} \cdot (L_{mit})$ Overall weight of MIT

$W_{ldpd} := 11 \cdot \frac{lbf}{ft} \cdot (L_{LDPD})$ Overall weight of LDPD

Allowable for temperature tree taken as AISC allowable stress

$$P_{allow} := \left(S_{aisc} - \frac{W_{temp}}{A_{6temp}} \right) \cdot \frac{S_{6temp}}{L_{6temp}}$$

Allowable force temperature tree.
Assume dynamic load factor of 1.1

$$\frac{P_{allow}}{1.1} = 366.043 lbf$$

$$P_{tempallow} := \frac{P_{allow}}{1.1} \qquad P_{tempallow} = 366.043 lbf$$

$$P_{temp} := \frac{P_{tempallow}}{A_{6temp}}$$

$$P_{temp} = 28.791 psi$$

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Allowable for thermowell taken as yield.

$$P_{therm} := \left(S_y - \frac{W_{therm}}{A_{therm}}\right) \cdot \frac{S_{therm}}{L_{therm}}$$

Allowable force sluice pit drain

Assume dynamic load factor of 1.1

$$\frac{P_{therm}}{1.1} = 70.821\,lbf$$

$$P_{thermpsi} := \frac{P_{therm}}{1.1 \cdot A_{therm}} \qquad P_{thermpsi} = 212.907\,psi$$

Allowable for sluice pit drain taken as yield stress.

$$P_{drain} := \left(S_y - \frac{W_{drain}}{A_{drain}}\right) \cdot \frac{S_{drain}}{L_{udrain}}$$

Allowable force sluice pit drain

Assume dynamic load factor of 1.1

$$\frac{P_{drain}}{1.1} = 100.026\,lbf$$

$$P_{drainpsi} := \frac{P_{drain}}{1.1 \cdot A_{drain}} \qquad P_{drainpsi} = 44.885\,psi$$

Allowable for VDDT taken as AISC.

$$P_{VDTT} := \left(S_{aisc} - \frac{W_{VDTT}}{A_{vdtt}}\right) \cdot \frac{S_{VDTT}}{L_{VDTT}}$$

Allowable force VDTT

Assume dynamic load factor of 1.1

$$\frac{P_{VDTT}}{1.1} = 61.702\,lbf$$

$$P_{VDTTpsi} := \frac{P_{VDTT}}{1.1 \cdot A_{vdtt}} \qquad P_{VDTTpsi} = 20.459\,psi$$

Allowable for 32" Transfer Pump taken as AISC

$$P_{transfer32} := \left(S_{aisc} - \frac{W_{transfer32}}{A_{transfer32}}\right) \cdot \frac{S_{transfer32}}{L_{transfer32}}$$

Allowable force 32" transfer pump

$$\frac{P_{transfer32}}{1.1} = 1.627 \times 10^4\,lbf$$

$$P_{allowtransfer32} := \frac{P_{transfer32}}{1.1}$$

Assume dynamic load factor of 1.1

$$P_{transfer32psi} := \frac{P_{allowtransfer32}}{A_{transfer32}} \qquad P_{transfer32psi} = 247.807\,psi$$

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Allowable for 11" Transfer Pump taken as AISC

$$P_{transfer11} := \left(S_{aisc} - \frac{W_{transfer11}}{A_{transfer11}}\right)\cdot\frac{S_{transfer11}}{L_{transfer11}}$$

Allowable force 11" transfer pump

$$\frac{P_{transfer11}}{1.1} = 1.273\times 10^{3}\,\text{lbf}$$

$$P_{allowtransfer11} := \frac{P_{transfer11}}{1.1}$$

Assume dynamic load factor of 1.1

$$P_{transfer11psi} := \frac{P_{allowtransfer11}}{A_{transfer11}} \qquad P_{transfer11psi} = 79.085\,\text{psi}$$

Allowable for 4" Transfer Pump in SY 102 Riser 23 taken as AISC

$$P_{transfer4} := \left(S_{aisc} - \frac{W_{transfer4}}{A_{transfer4}}\right)\cdot\frac{S_{transfer4}}{L_{transfer4}}$$

Allowable force 4" transfer pump

$$\frac{P_{transfer4}}{1.1} = 106.306\,\text{lbf}$$

$$P_{allowtransfer4} := \frac{P_{transfer4}}{1.1}$$

Assume dynamic load factor of 1.1

$$P_{transfer4psi} := \frac{P_{allowtransfer4}}{A_{transfer4}} \qquad P_{transfer4psi} = 33.492\,\text{psi}$$

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Allowable for RDW taken as yield

$$P_{rdw} := \left(S_y - \frac{W_{rdw}}{A_{rdw}}\right) \cdot \frac{S_{rdw}}{L_{rdw}}$$

Allowable force RDW

$$\frac{P_{rdw}}{1.1} = 269.554\,lbf$$

$$P_{allowrdw} := \frac{P_{rdw}}{1.1}$$

Assume dynamic load factor of 1.1

$$P_{rdwpsi} := \frac{P_{allowrdw}}{A_{rdw}} \qquad P_{rdwpsi} = 62.689\,psi$$

Allowable for MIT taken as AISC

$$P_{mit} := \left(S_{aisc} - \frac{W_{mit}}{A_{mit}}\right) \cdot \frac{S_{mit}}{L_{mit}}$$

Allowable force MIT

$$\frac{P_{mit}}{1.1} = 41.373\,lbf$$

$$P_{allowmit} := \frac{P_{mit}}{1.1}$$

Assume dynamic load factor of 1.1

$$P_{mitpsi} := \frac{P_{allowmit}}{A_{mit}} \qquad P_{mitpsi} = 21.151\,psi$$

Allowable for LDPD taken as yield

$$P_{ldpd} := \left(S_y - \frac{W_{ldpd}}{A_{ldpd}}\right) \cdot \frac{S_{LDPD}}{L_{LDPD}}$$

Allowable force LDPD

$$\frac{P_{ldpd}}{1.1} = 210.914\,lbf$$

$$P_{allowldpd} := \frac{P_{ldpd}}{1.1}$$

Assume dynamic load factor of 1.1

$$P_{ldpdpsi} := \frac{P_{allowldpd}}{A_{ldpd}} \qquad P_{ldpdpsi} = 66.45\,psi$$

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Determine the Limit Load (Allowable Deflection) for each component:

Limit load for sluice pit drain

$K_{ldrain} = 1.353$

$L_{allowsluice} := P_{drain} \cdot K_{ldrain}$ $\qquad$ $L_{allowsluice} = 148.878\,lbf$

$z_{sluice} := 0 \cdot in$

$$\delta_{sluice} := \frac{1}{6} \cdot \frac{L_{allowsluice}}{E \cdot I_{drain}} \cdot \left(z_{drain}^{\;3} - 3 \cdot L_{drain}^{\;2} z_{drain} + 2 \cdot L_{drain}^{\;3} \right) \qquad \delta_{sluice} = 58.137\,in$$

Limit load allowable for New 6" temperature tree

$K_{l6temp} = 1.479$

$L_{allowtemp} := P_{tempallow} \cdot K_{l6temp}$

$L_{allowtemp} = 541.467\,lbf$

$$\delta_{6temp} := \frac{1}{6} \cdot \frac{L_{allowtemp}}{E \cdot I_{6temp}} \cdot \left(z_{6temp}^{\;3} - 3 \cdot L_{6temp}^{\;2} z_{6temp} + 2 \cdot L_{6temp}^{\;3} \right) \qquad \delta_{6temp} = 42.947\,in$$

Limit load for thermowells

$K_{ltherm} = 1.413$ $\qquad$ $P_{allowtherm} := 154\,lbf$

$L_{allowtherm} := P_{allowtherm} \cdot K_{ltherm}$ $\qquad$ $L_{allowtherm} = 217.626\,lbf$

$$\delta_{therm} := \frac{1}{6} \cdot \frac{L_{allowtherm}}{E \cdot I_{therm}} \cdot \left(z_{therm}^{\;3} - 3 \cdot L_{therm}^{\;2} z_{therm} + 2 \cdot L_{therm}^{\;3} \right) \qquad \delta_{therm} = 1.329\,in$$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 63 of 69 + Attachment 1
Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis	Orig: D. Clements D.C	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System	Checker: M. Vanderzanden MV	Date: 9/27/00

Limit load Allowable for leak detection pit drain

$K_{lldpd} = 1.341$

$L_{allowldpd} := P_{allowldpd} \cdot K_{lldpd}$ $\qquad L_{allowldpd} = 282.892\,\text{lbf}$

$$\delta_{ldpd} := \frac{1}{6} \cdot \frac{L_{allowldpd}}{E \cdot I_{LDPD}} \cdot \left(z_{LDPD}^{3} - 3 \cdot L_{LDPD}^{2} z_{LDPD} + 2 \cdot L_{LDPD}^{3} \right) \qquad \delta_{ldpd} = 31.901\,\text{in}$$

Limit load Allowable for ALCs

$P_{allowALC} := 603\,\text{lbf}$

$K_{lalc} = 1.293$

$L_{allowalc} := K_{lalc} \cdot P_{allowALC}$ $\qquad L_{allowalc} = 779.8\,\text{lbf}$

$$\delta_{alc} := \frac{1}{6} \cdot \frac{L_{allowalc}}{E \cdot I_{alc}} \cdot \left(z_{alc}^{3} - 3 \cdot L_{alc}^{2} z_{alc} + 2 \cdot L_{alc}^{3} \right) \qquad \delta_{alc} = 2.329\,\text{in}$$

Limit load Allowable for Vel Den Temp Tree

$K_{lVDTT} = 1.385$ $\qquad L_{allowVDTT} := K_{lVDTT} \cdot \frac{P_{VDTT}}{1.1}$

$$\delta_{VDTT} := \frac{1}{6} \cdot \frac{L_{allowVDTT}}{E \cdot I_{VDTT}} \cdot \left(z_{VDTT}^{3} - 3 \cdot L_{VDTT}^{2} z_{VDTT} + 2 \cdot L_{VDTT}^{3} \right) \qquad \delta_{VDTT} = 67.094\,\text{in}$$

Limit load allowable for New 11" Transfer Pump

$K_{ltransfer11} = 1.333$

$L_{allowtransfer11} := K_{ltransfer11} \cdot P_{allowtransfer11}$

$$\delta_{transfer11} := \frac{1}{6} \cdot \frac{L_{allowtransfer11}}{E \cdot I_{transfer11}} \cdot \left(z_{transfer}^{3} - 3 \cdot L_{transfer11}^{2} z_{transfer} + 2 \cdot L_{transfer11}^{3} \right)$$

$\delta_{transfer11} = 15.569\,\text{in}$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 64 of 69 + Attachment 1

Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis	Orig: D. Clements D.C	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System	Checker: M. Vanderzanden MV	Date: 9/27/00

Limit load allowable for New 32" Transfer Pump

$K_{ltransfer32} = 1.3$

$L_{allowtransfer32} := K_{ltransfer32} \cdot P_{allowtransfer32}$

$$\delta_{transfer32} := \frac{1}{6} \cdot \frac{L_{allowtransfer32}}{E \cdot I_{transfer32}} \cdot \left(z_{transfer}^{3} - 3 \cdot L_{transfer32}^{2} z_{transfer} + 2 \cdot L_{transfer32}^{3} \right)$$

$\delta_{transfer32} = 5.086in$

Limit load allowable for 4" SY 101 Riser 23 Transfer Pump

$K_{ltransfer4} = 1.341$

$L_{allowtransfer4} := K_{ltransfer4} \cdot P_{allowtransfer4}$

$$\delta_{transfer4} := \frac{1}{6} \cdot \frac{L_{allowtransfer4}}{E \cdot I_{transfer4}} \cdot \left(z_{transfer}^{3} - 3 \cdot L_{transfer4}^{2} z_{transfer} + 2 \cdot L_{transfer4}^{3} \right)$$

$\delta_{transfer4} = 35.68 lin$

Limit load allowable for Radiation Dry Well

$K_{lrdw} = 1.333$

$L_{allowrdw} := K_{lrdw} \cdot P_{allowrdw}$

$$\delta_{rdw} := \frac{1}{6} \cdot \frac{L_{allowrdw}}{E \cdot I_{rdw}} \cdot \left(z_{rdw}^{3} - 3 \cdot L_{rdw}^{2} z_{rdw} + 2 \cdot L_{rdw}^{3} \right)$$

$\delta_{rdw} = 44.927in$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 65 of 69 + Attachment 1

Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis	Orig: D. Clements D.C	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System	Checker: M. Vanderzanden MV	Date: 9/27/00

Limit load allowable for MIT

$K_{lmit} = 1.343$

$L_{allowmit} := K_{lmit} \cdot P_{allowmit}$

$\delta_{mit} := \frac{1}{6} \cdot \frac{L_{allowmit}}{E \cdot I_{mit}} \cdot \left(z_{MIT}{}^{3} - 3 \cdot L_{mit}{}^{2} z_{MIT} + 2 \cdot L_{mit}{}^{3} \right)$ $\qquad \delta_{mit} = 67.477 in$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F		Calc. #:ME-07 Rev: C Page: 66 of 69 + Attachment 1
Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis		Orig: D. Clements D.C	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System		Checker: M. Vanderzanden MV	Date: 9/27/00

Determine the force allowable for the tank wall.

For conservatism in determining the allowable for the tank wall, assume no backing by concrete bu just a 1/4" thick, 75 foot diameter pipe.

$D_{owall} := 75\cdot ft + 2\cdot .25\cdot in$

$D_{iwall} := 75\cdot ft$ Tank wall Properties

$t_{wall} := .25\cdot in$

$A_{wall} := \frac{\pi}{4}\cdot\left(D_{owall}^{2} - D_{iwall}^{2}\right)$

$h_{wall} := 50\cdot ft$

$W_{wall} := \delta\cdot A_{wall}\cdot h_{wall}$

$c_{wall} := \frac{D_{owall}}{2}$

$I_{wall} := \frac{\pi}{64}\left(D_{owall}^{4} - D_{iwall}^{4}\right)$

$S_{wall} := \frac{I_{wall}}{c_{wall}}$

$L_{wall} := 50\cdot ft$

$P_{wall} := \left(S_{aisc} - \frac{W_{wall}}{A_{wall}}\right)\cdot\frac{S_{wall}}{L_{wall}}$

Allowable force tank wall

Assume dynamic load factor of 1.1

$\frac{P_{wall}}{1.1} = 4.732\times 10^{6}\,lbf$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: 67 of 69 + Attachment1
Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis	Orig: D. Clements DC	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System	Checker: M. Vanderzanden MV	Date: 9/27/00

Determine the Stress in the Riser Flange to Component Interface from the Impingement Force Cantilever Point Load

Use the 100% pump speed worst case impingement force for each component from Section 1.

$P_{rdw} := 103.5 lbf$ $\qquad P_{vdtt} := 104 lbf$ $\qquad P_{mit} := 88.2 lbf$

$P_{ALC} := 609 lbf$ $\qquad P_{sluice} := 276 lbf$ $\qquad P_{temp} := 103.5 lbf$

$P_{11} := 89.8 lbf$ $\qquad P_{32} := 148.7 lbf$ $\qquad P_4 := 102.5 lbf$

$$S_{rdw} := \frac{P_{rdw} \cdot L_{rdw} \cdot c_{rdw}}{I_{rdw}} \qquad S_{rdw} = 1.041 \times 10^4 \, psi$$

$$S_{vdtt} := \frac{P_{vdtt} \cdot L_{VDTT} \cdot c_{vdtt}}{I_{VDTT}} \qquad S_{vdtt} = 3.006 \times 10^4 \, psi$$

$$S_{mit} := \frac{P_{mit} \cdot L_{mit} \cdot c_{mit}}{I_{mit}} \qquad S_{mit} = 3.772 \times 10^4 \, psi$$

Determine properties for 6" sch. 80 top portion of ALC pipe for stress in that pipe from force.

$D_{ialc6} := 5.761 in$ $\qquad t_{walc6} := .432 in$

$$D_{oalc6} := \left(D_{ialc6} + 2 \cdot t_{walc6}\right)$$

$$c_{alc6} := \frac{D_{oalc6}}{2} \qquad I_{alc6} := \frac{\pi}{64} \cdot \left(D_{oalc6}^{\ 4} - D_{ialc6}^{\ 4}\right)$$

$$S_{ALC} := \frac{P_{ALC} \cdot L_{alc} \cdot c_{alc6}}{I_{alc6}} \qquad S_{ALC} = 3.109 \times 10^4 \, psi$$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F		Calc. #:ME-07 Rev: C Page: 68 of 69 + Attachment 1
Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis		Orig: D. Clements D.C	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System		Checker: M. Vanderzanden MV	Date: 9/27/00

$$S_{sluice} := \frac{P_{sluice} \cdot (L_{drain} + L_T) \cdot c_{drain}}{I_{drain}} \qquad S_{sluice} = 1.1 \times 10^5 \, psi$$

$$S_{temp} := \frac{P_{temp} \cdot L_{temp} \cdot c}{I_{6temp}} \qquad S_{temp} = 5.51 \times 10^3 \, psi$$

$$S_{11} := \frac{P_{11} \cdot L_{transfer11} \cdot c_{transfer11}}{I_{transfer11}} \qquad S_{11} = 1.259 \times 10^3 \, psi$$

$$S_{32} := \frac{P_{32} \cdot L_{transfer32} \cdot c_{transfer32}}{I_{transfer32}} \qquad S_{32} = 163.115 \, psi$$

$$S_4 := \frac{P_4 \cdot L_{transfer4} \cdot c_{transfer4}}{I_{transfer4}} \qquad S_4 = 1.722 \times 10^4 \, psi$$

Use 70% pump speed worst case impingement force for each component from Section 1

$P_{rdw70} := 47 \cdot lbf$ $\qquad P_{vdtt70} := 47.8\,lbf$ $\qquad P_{mit70} := 48 \cdot lbf$

$P_{ALC70} := 167 \cdot lbf$ $\qquad P_{sluice70} := 81 \cdot lbf$ $\qquad P_{temp70} := 48\,lbf$

$P_{1170} := 40.8\,lbf$ $\qquad P_{3270} := 49.5\,lbf$ $\qquad P_{470} := 45.4\,lbf$

$$S_{rdw70} := \frac{P_{rdw70} \cdot L_{rdw} \cdot c_{rdw}}{I_{rdw}} \qquad S_{rdw70} = 4.728 \times 10^3 \, psi$$

HNDTEAM	**DESIGN CALCULATION SHEET** **Form EP-3.3-2F**	Calc. #:ME-07 Rev: C Page: 69 of 69 + Attachment 1
Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis	Orig: D. Clements DC	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System	Checker: M. Vanderzanden MV	Date: 9/27/00

$$S_{vdtt70} := \frac{P_{vdtt70} \cdot L_{VDTT} \cdot c_{vdtt}}{I_{VDTT}} \qquad S_{vdtt70} = 1.382 \times 10^{4}\,\text{psi}$$

$$S_{mit70} := \frac{P_{mit70} \cdot L_{mit} \cdot c_{mit}}{I_{mit}} \qquad S_{mit70} = 2.053 \times 10^{4}\,\text{psi}$$

$$S_{ALC70} := \frac{P_{ALC70} \cdot L_{alc} \cdot c_{alc6}}{I_{alc6}} \qquad S_{ALC70} = 8.525 \times 10^{3}\,\text{psi}$$

$$S_{sluice70} := \frac{P_{sluice70} \cdot \left(L_{drain} + L_{T}\right) \cdot c_{drain}}{I_{drain}} \qquad S_{sluice70} = 3.228 \times 10^{4}\,\text{psi}$$

$$S_{temp70} := \frac{P_{temp70} \cdot L_{temp} \cdot c}{I_{6temp}} \qquad S_{temp70} = 2.555 \times 10^{3}\,\text{psi}$$

$$S_{1170} := \frac{P_{1170} \cdot L_{transfer11} \cdot c_{transfer11}}{I_{transfer11}} \qquad S_{1170} = 572.177\,\text{psi}$$

$$S_{3270} := \frac{P_{3270} \cdot L_{transfer32} \cdot c_{transfer32}}{I_{transfer32}} \qquad S_{3270} = 54.298\,\text{psi}$$

$$S_{470} := \frac{P_{470} \cdot L_{transfer4} \cdot c_{transfer4}}{I_{transfer4}} \qquad S_{470} = 7.627 \times 10^{3}\,\text{psi}$$

HNDTEAM	DESIGN CALCULATION SHEET Form EP-3.3-2F	Calc. #:ME-07 Rev: C Page: A-1 of A-56

Design Calculation Title: W-523 In Tank Component Impingement and Deflection Analysis	Orig: R. Spencer	Date: 9/27/00
Project No. & Title: 4412-046, W-523 Advanced Conceptual Waste Feed Delivery System	Checker: D.Clements	Date: 9/26/00

Attachment 1

Summary of Mixer Pump Jet Impingement Force and Fatigue Results

CALC # ME-07
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Tank: AW-101 (These results conservatively bound results for Tanks AW-103 and AW-104)

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	270	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	85	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

Riser No.	Function	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Distance from nozzle to object CL Mixer #1 (ft)	Distance from nozzle to object CL Mixer #2 (ft)	Pole dia with sludge (ft)	Impingment Forces (lbf) 70% Mixer #1	Impingment Forces (lbf) 70% Mixer #2	Impingment Forces (lbf) 100% Mixer #1	Impingment Forces (lbf) 100% Mixer #2	Allowable Force AISC (lbf)	Deflections (in) 70% Mixer #1	Deflections (in) 70% Mixer #2	Deflections (in) 100% Mixer #1	Deflections (in) 100% Mixer #2	Allowable Deflection (in)
5	(New) Temperature Tree	90	3.0	Y	6	(3)	23.0	17.0	22.5	16.5	1.08	40.7	42.1	80.31	88.7	366	3.2	3.3	6.4	7	AISC 42.9
12	(New) Transfer Pump	270	3.0	Y	11	(1)	17.0	23.0	16.5	22.5	1.5	41.6	40.8	105.7	89.4	1273	0.4	0.4	0.96	0.82	AISC 15.5
12	(New) Transfer Pump	270	3.0	Y	32	(2)	17.0	23.0	16.5	22.5	3.25	59.4	49.3	191.5	147.6	16270	0.01	0.01	0.05	0.04	AISC 5.1

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 11" for evaluation purposes
(2) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 32" for evaluation purposes
(3) Assumed to be New 6" Temperature Tree
(4) Stresses at riser flange to component are bounded in other tanks

9/27/00

MDC 9/20/00
RBB 9/27/00

CALC# ME-07
page A-3 of A-6
MOC 9/26/00
ABS 9/27/00

Tank: AY-101 (These results conservatively bound results for AY-102)

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 01C (new mixer pump)	0	22.0
Mixer Pump #2 in Riser 01A (new mixer pump)	180	22.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

Riser No.	Component	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	Nozzle to object CL Mixer #1 (ft)	Nozzle to object CL Mixer #2 (ft)	Pole Dia. w/Sludge (ft)	Impingment Forces (lbf) 70% Mixer #1	Impingment Forces (lbf) 70% Mixer #2	Impingment Forces (lbf) 100% Mixer #1	Impingment Forces (lbf) 100% Mixer #2	Allowable Force (lbf)	70% Stress (psi) Riser Flange to Component	100% Stress (psi) Riser Flange to Component	Deflections (in) 70% Mixer #1	Deflections (in) 70% Mixer #2	Deflections (in) 100% Mixer #1	Deflections (in) 100% Mixer #2	Allowable Deflection (in)
2	Air Lift Circulator 101-4	192.9	14.5	Y	30	(6)	38.3	8.5	35.8	8.0	3.08		101		352	Julyk 603				0.3		1	Sy 2.3
3	Thermocouple for ALC 101-4	198.1	14.5	Y	0.75		36.1	8.5	35.6	8.0	0.65		41		148	Julyk 154				0.25		0.9	Sy 1.3
2	Air Lift Circulator 101-7	344.4	14.5	Y	30	(6)	8.9	36.2	7.7	35.7	3.08	97		336		Julyk 603			0.3		1.1		Sy 2.3
3	Thermocouple for ALC 101-7	349.5	14.5	Y	0.75		8.9	36.2	8.4	35.7	0.65	41		145		Julyk 154			0.25		0.9		Sy 1.3
2	Air Lift Circulator 101-14	182.1	27.0	Y	30	(6)	49.0	5.1	48.5	4.6	3.08		167		609	Julyk 603	8525	31090 (note 5)		0.5		1.8	Sy 2.3
3	Thermocouple for ALC 101-14	184.9	27.0	Y	0.75		49.0	5.1	48.5	4.6	0.65		49		96	Julyk 154				0.3		0.6	Sy 1.3
2	Air Lift Circulator 101-21	358.4	27.0	Y	30	(6)	5.0	49.0	4.5	48.5	3.08	170		609		Julyk 603			0.5		1.8		Sy 2.3
3	Thermocouple for ALC 101-21	1.1	27.0	Y	0.75		5.0	49.0	4.5	48.5	0.65	49		99		Julyk 154			0.3		0.61		Sy 1.3
6A	(New) Transfer Pump/Drop Leg	90	6.0	Y	11	(1)	22.8	22.8	22.3	22.3	1.5	40.8	40.8	89.8	89.8	AISC 1273	752	1259	0.37	0.37	0.82	0.82	AISC 15.5
6A	(New) Transfer Pump/Drop Leg	90	6.0	Y	32	(2)	22.8	22.8	22.3	22.3	3.25	49.5	49.5	148.7	148.7	AISC 16270	54	163	0.01	0.01	0.04	0.04	AISC 5
10A	Sluice Pit Drain 01D	176.3	19.0	Y	3	(4)	41.0	3.3	40.5	2.7	0.83		81		276	Sy 100	32228	110 ksi (note 5)		31.6		107.8	Sy 58
10C	Sluice Pit Drain 01B	356.3	19.0	Y	3	(4)	3.3	41.0	2.8	40.5	0.83	81		276		Sy 100			31.6		107.8		Sy 58
11A	Leak Detection Pit Drain	131.3	32.0	Y	4	(4)	49.4	24.1	48.9	23.6	0.92	43.5	45.7	88.6	78.3	Sy 210			4.9	5.2	10	8.8	Sy 32
13A	Profile Thermocouple Probe	38.1	34.8	Y	4	(4)	22.1	53.8	21.6	53.3	0.92	44.2	42.7	78.7	90.2	Sy 40			24.3	23.3	43	49.4	Sy 76.3
13B	Profile Thermocouple Probe	128.1	34.8	Y	4	(4)	51.3	27.4	50.8	26.9	0.92	43.8	46.6	89.3	78.6	Sy 40			23.9	25.6	48.9	43	Sy 76.3
13C	Profile Thermocouple Probe	218.1	34.8	Y	4	(4)	53.8	22.1	53.3	21.6	0.92	42.7	44.2	90.2	78.7	Sy 40			23.3	24.3	49.4	43	Sy 76.3
13D	Profile Thermocouple Probe	308.1	34.8	Y	4	(4)	27.4	51.3	26.9	50.8	0.92	46.6	43.8	78.5	89.3	Sy 40			25.6	23.9	43	49	Sy 76.3
14A	Dry Well	150	12.5	Y	6	(4)	33.4	12.8	32.9	12.3	1.08	47	41.4	78.7	103.5	Sy 269			3.2	2.8	5.3	7	AISC 29.6
14B	Dry Well	30	12.5	Y	6	(4)	12.8	33.4	12.3	32.9	1.08	41.4	47	103.5	78.7	Sy 269	4728	10410	2.8	3.2	7	5.3	AISC 29.6
14C	Dry Well	270	12.5	Y	6	(4)	25.3	25.3	24.8	24.8	1.08	43.9	43.9	79	79	Sy 269							AISC 29.6
14D	Dry Well	129.7	34.8	Y	6	(4)	51.6	26.8	51.1	26.3	1.08	46.1	44.6	85.9	78.6	Sy 269			Max are above		Max. are above		
14E	Dry Well	39.7	34.8	Y	6	(4)	22.7	53.7	22.2	53.2	1.08	42.7	46	80.5	86.8	Sy 269							
14F	Dry Well	309.7	34.8	Y	6	(4)	26.8	51.6	26.3	51.1	1.08	44.6	46.1	78.6	85.9	Sy 269							
14G	Dry Well	219.7	34.8	Y	6	(4)	53.6	22.7	53.1	22.2	1.08	46	42.7	86.8	80.5	Sy 269							
15A	(New) Temperature Tree	145.4	12.5	Y	6	(3)	13.8	33.8	13.3	33.3	1.08	41	47	98.9	78.8	AISC 366	2339	5044	3.3	3.7	7.8	6.3	AISC 42.9
15D	(New) Temperature Tree	176.3	34.8	Y	6	(3)	56.8	56.8	56.3	12.4	1.08	45	41.3	88	102.9	AISC 366			3.6	3.4	7	8.2	AISC 42.9
15H	(New) Temperature Tree	87.9	34.8	Y	6	(3)	40.5	40.5	40.0	41.3	1.08	48	48	81	81.6	AISC 366	2555		3.8	3.8	4.3	4.5	AISC 42.9
15L	(New) Temperature Tree	357.9	34.8	Y	6	(3)	12.8	12.0	12.3	56.3	1.08	41.4	45	103.5	88	AISC 366		5510	3.3	3.6	8.2	7	AISC 42.9
15P	(New) Temperature Tree	267.9	34.8	Y	6	(3)	41.8	33.1	41.3	40.0	1.08	48	48	81.6	81.1	AISC 366			3.8	3.8	6.5	6.4	AISC 42.9
Wall	Closest Primary Tank Wall	n/a	37.5	Y	n/a		15.5	15.5	15.0	15.0		247	247	913	913	AISC 4.7x10e6							

Notes (1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 11" for evaluation purposes
Notes (2) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 32" for evaluation purposes
(3) Assumed to be New 6" Temperature Tree
(4) Diameter conservatively assumed to be the diameter of riser.
(5) Allowable yield stress taken as 28,000 psi for A53 Carbon Steel.

9/28/00

CALC # ME-07
page A-4 of A6

Tank: SY-101 (These results conservatively bound results for Tank S-103)

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	90	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	270	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

Riser No.	Function	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL) Mixer #1 (ft)	Distance (CL-CL) Mixer #2 (ft)	nozzle to object CL Mixer #1 (ft)	nozzle to object CL Mixer #2 (ft)	Pole Dia. w/sludge (ft)	Impingement Forces (lbf) 70% Mixer #1	Impingement Forces (lbf) 70% Mixer #2	Impingement Forces (lbf) 100% Mixer #1	Impingement Forces (lbf) 100% Mixer #2	Allowable Force AISC (lbf)	70% Stress (psi) Riser Flange to Component	100% Stress (psi) Riser Flange to Component	Deflections (in) 70% Mixer #1	Deflections (in) 70% Mixer #2	Deflections (in) 100% Mixer #1	Deflections (in) 100% Mixer #2	Allowable Deflection (in)	AISC
3	Vel Den Temp Tree	300	20.0	Y	3.5		38.6	10.4	38.1	9.9	0.875	47.8	41.8	84.1	104	61	13820	30060 (note 5)	37.5	32.9	66.1	81.7	Sy 102	67
5	(New) Temperature Tree	90	3.0	Y	6	(3)	17.0	23.0	16.5	22.5	1.08	40.8	42.9	88.7	80.31	366	2339	5044	3.2	3.4	7	6.4	AISC 42.9	
13	New Transfer Pump	270	3.0	Y	11	(1)	23.0	17.0	22.5	16.5	1.5	40.8	41.6	89.4	105.7	1273	572	1259	0.48	0.6	1.5	1.9	AISC 15.6	
13	New Transfer Pump	270	3.0	Y	32	(2)	23.0	17.0	22.5	16.5	3.25	49.3	61.5	147.6	191.5	16270	54	163	0.4	0.4	0.87	1	AISC 5.1	
15	Vel Den Temp Tree	300	28.0	Y	3.5		46.4	14.6	45.9	14.1	0.875	45.8	40.8	88.2	86.8	61			36	32	69.3	68.2	Sy 102	67
18	Multi-Functional Instrument Tree	0	28.0	Y	3.5		34.4	34.4	33.9	33.9	0.875	48	48.0	81.8	81.8	42	20500		58.3	58.3	98.4	98.4	Sy 102	67
19	Multi-Functional Instrument Tree	120	28.0	Y	3.5		14.6	46.4	14.1	45.9	0.875	41	44.9	86.8	88.2	42		37000 (note 5)	49.8	54.5	107.6	105.8	Sy 102	67
18	Multi-Functional Instrument Tree	0	28.0	Y	3.5	(4)	34.4	34.4	33.9	33.9	0.875	48	48.0	81.8	81.8	42			24.8	24.6	41.8	41.8	Sy 102	67
19	Multi-Functional Instrument Tree	120	28.0	Y	3.5	(4)	14.6	46.4	14.1	45.9	0.875	41	44.9	86.8	88.2	42			21.2	23.2	45.6	45	Sy 102	67

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 11" for evaluation purposes
(2) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 32" for evaluation purposes
(3) Assumed to be New 6" Temperature Tree
(4) Moment Arm taken from bottom of riser.
(5) Allowable yield stress taken as 28,000 psi for A53 Carbon Steel

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Tank: SY-102

Waste Density: 1.4 * (Water Density)
Waste Viscosity: 30 centipoise

	Pos Ang (degrees)	Pos Rad (ft)
Mixer Pump #1 in Riser 7 (new mixer pump)	90	20.0
Mixer Pump #2 in Riser 8 (new mixer pump)	270	20.0

Distance from pump CL to edge of nozzle (ft) 0.5 (see note 1)

Riser No.	Function (as originally defined)	Pos Ang (degrees)	Pos Rad (ft)	Below Waste (Y/N)	Size Diam (in)	Notes	Distance (CL-CL)		to object CL		Pole dia. w/Sludge (ft)	Impingment Forces (lbf)				Allowable Force AISC (lbf)	70% Stress (psi) Riser Flange to Component	100% Stress (psi) Riser Flange to Component	Deflections (in)				Allowable Deflection (in)
							Mixer #1 (ft)	Mixer #2 (ft)	Mixer #1 (ft)	Mixer #2 (ft)		70% Mixer #1	70% Mixer #2	100% Mixer #1	100% Mixer #2				70% Mixer #1	70% Mixer #2	100% Mixer #1	100% Mixer #2	
5	(New) Temperature Tree	90.0	3.0	Y	6	(3)	17.0	23.0	16.5	22.5	1.06	40.8	42.9	88.7	80.3	366	2339	5044	3.2	3.4	7.4	8.4	AISC 42.9
13	(New) Transfer Pump	270.0	3.0	Y	11	(1)	23.0	17.0	22.5	16.5	1.5	40.8	41.6	89.4	105.7	1273	1259	572	0.48	0.6	1.4	2	AISC 15.5
13	(New) Transfer Pump	270.0	3.0	Y	32	(2)	23.0	17.0	22.5	16.5	3.25	49.3	61.5	147.6	199.9	16270	163	54	0.4	0.4	1.4	2	AISC 5.1
23	Supernate Feed Pump	284.0	30.0	Y	4.5		49.6	11.6	49.1	11.1	0.96	45.4	41.3	87.6	102.5	106	7627	17220	11.4	10.3	21.9	25.7	AISC 35.7

Notes
(1) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 11" for evaluation purposes
(2) Make and model of new mixer pumps have yet to be specified; nozzle length from CL conservatively assumed 6 inches (0.5 ft); diameter assumed to be 32" for evaluation purposes
(3) Assumed to be New 6" Temperature Tree
(4) Allowable yield stress taken as 28,000 psi for A53 Carbon Steel

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RBS 9/27/00

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	Assume that components have allowable stress to 28,000 psi			Assume that 50,000 cycles are needed		Assume that 100,000 cycles are needed		Assume that 200,000 cycles are needed		Assume that 400,000 cycles are needed		Assume that 800,000 cycles are needed	
	50 days			3 months		6 months		1 Year		2 Years		4 Years	
Component	Yield (psi)	Force to Provide Yield Stress	Allowed Fatigue Cycles	Stress (psi)	Maximum Force	Stress (psi)	Maximum Force	Stress (psi)	Maximum Force	Stress (psi)	Maximum Force	Stress (psi)	Maximum Force
6" Temp Tree	28000	526.0	20000	16000	300.6	12000	225.4	10000	187.9	9000	169.1	8000	150.3
Sluice Pit Drain	28000	70.3	20000	16000	40.2	12000	30.1	10000	25.1	9000	22.6	8000	20.1
ALC	28000	594.2	20000	16000	339.5	12000	254.7	10000	212.2	9000	191.0	8000	169.8
VDTT	28000	96.9	20000	16000	55.4	12000	41.5	10000	34.6	9000	31.1	8000	27.7
11" Transfer Pump	28000	2000.2	20000	16000	1143.0	12000	857.2	10000	714.4	9000	642.9	8000	571.5
32" Transfer Pump	28000	25525.6	20000	16000	14586.1	12000	10939.5	10000	9116.3	9000	8204.7	8000	7293.0
4" Transfer Pump	28000	166.7	20000	16000	95.2	12000	71.4	10000	59.5	9000	53.6	8000	47.6
RDW	28000	278.3	20000	16000	159.0	12000	119.3	10000	99.4	9000	89.5	8000	79.5
MIT	28000	65.5	20000	16000	37.4	12000	28.1	10000	23.4	9000	21.0	8000	18.7

Reference: Winkel, 1989

Force to provide yield stress or maximum force = impingment force.

ABS 9/27/00

Attachment C

Attachment C

Heating, Ventilation, and Air Conditioning Scope Refinements

REFINE VENTILATION SCOPE

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Release 46
Report No. 990920203-023
ACDR Subtask 3
Revision 0

September 2000

prepared by

HND TEAM

REFINE VENTILATION SCOPE

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

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Contract No. 4412, Release 46
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September 2000

Prepared by: Scott R. Pierce, P.E.
Steven Weaver

Approved by: R L Fritz
Robert L. Fritz

Date: 9-30-00

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Tables

Acronyms

CAM	Continuous Air Monitor
CDR	Conceptual Design Report
CFM	Cubic Feet per Minute
CTB	Cost-to-Benefit
DST	Double-Shell Tank
PLC	Programmable Logic Controller
WFD	Waste Feed Delivery Project
WTF	Waste Treatment Facility

1.0 INTRODUCTION

This task reviewed RPP-6333, Revision 0, *Project W-521 Waste Feed Delivery System Conceptual Design Report*, (CHG, 2000c) as it pertains to the Aging Waste ventilation systems. Four discrete subtasks were performed. A description of each activity follows:

- During Conceptual Design activities, a regulatory interpretation recommended installing a fully redundant secondary train in the primary ventilation system as a means to reduce the risk of a system failure. This revision was captured in the Conceptual Design Report (CDR) (CHG 2000c). This subtask assesses the reliability of the primary ventilation system relative to its ability to support waste transfer to the Waste Treatment Facility (WTF) and recommends the minimum upgrades to achieve the goal. This subtask includes performing a cost-to-benefit (CTB) analysis of incrementally reducing the number of redundant components recommended in the Conceptual Design. At the client's direction, the analysis only considered the probability of success associated with reducing the number of redundant components; the analysis did not consider the consequence of a system failure.

- The Conceptual Design includes a new catch tank and lift station that will transfer ventilation condensate to the 241-AY and 241-AZ tanks. This subtask considers options for reducing the cost of this design.

- Document HNF-5196, Revision 0, *Double-Shell Tank Ventilation Subsystem Specification*, HNF-5196, Rev. 0 (CHG 2000a), has been issued since completion of the Conceptual Design and requires a minimum airflow of 850 cfm through the annulus air slots of the 241-AY and 241-AZ tanks. The existing 241-AY and 241-AZ annulus ventilation systems do not provide such airflow. This subtask considered several options to achieve the required flow rate. The subtask develops cost estimates for implementing the preferred option.

- This subtask reviews the CDR (CHG 2000c) and compares the design with the requirements of the newly released CHG (2000a).

The following sections discuss each of these subtasks. Section 2.0 describes the options for improving the reliability of the 241-AZ-702 HEME and Condenser. Section 3.0 describes the options for transferring condensate from the 241-AZ-702 building to the Aging Waste tanks. Section 4.0 discusses the design and cost estimate required to increase the airflow through the air slots under the 241-AY and 241-AZ tanks. Section 5.0 compares the Conceptual Design with the newly released CHG (2000a).

2.0 SUBTASK 1: AGA FOR THE AY/AZ PRIMARY VENTILATION SYSTEM 702-AZ

The Conceptual Design for Project W-521 includes modifications to the 241-AZ-702 primary ventilation system. These modifications will provide a fully redundant secondary train through the system. This subtask prepared an Alternative Generation Analysis (Appendix A) to reevaluate the necessity of a fully redundant train. This analysis assessed the reliability of the primary ventilation system relative to its ability to support waste transfer to the vitrification facility, and recommended the minimum upgrades to achieve this goal. The assessment included a CTB analysis for adding redundant components. The analysis concluded that the modifications contained in the CDR are not necessary. Rather, the potential of system failure can be sufficiently mitigated through the practice of increased maintenance during double-shell tank (DST) pre-transfer operations. See Appendix A for a complete discussion of the analysis and its findings.

3.0 SUBTASK 2: RETURNING CONDENSATE TO THE AGING WASTE TANKS

3.1 Purpose

Condensate from the 241-AZ-702 building currently drains to the 241-AZ-151 catch tank. The catch tank is non-compliant and will be initially decommissioned as a part of the execution of W-521, Waste Feed Delivery Project (WFD). As a consequence, the drain line from 241-AZ-702 building must be rerouted.

As described in the CDR (CHG 2000c), the condensate from the 241-AZ-702 building will flow through a gravity drain to tank 241-AZ-102. Tank Farm Operations has requested that the redesigned condensate drain system allow routing to any of the 241-AY and 241-AZ tanks (not just tank 241-AZ-102). The grade differences within the 241-AY and 241-AZ tank farms will necessitate pumping the waste to all but the planned tank 241-AZ-102.

Two options were developed for rerouting the 241-AZ-702 building drain. With one, a new compliant catch tank is installed that has pumping capabilities. In the other, the existing seal pot in the 241-AZ-702 building is modified to incorporate a pump and valving to move the waste to the 241-AY and 241-AZ tanks.

3.2 Scope

The scope of this activity is limited to rerouting the 241-AZ-702 building drain line. Other drains that lead to the 241-AZ-151 catch tank are not part of this activity.

3.3 Methodology

For each option, sketches were developed. Cost estimates for each option then were prepared using the sketches. These estimates were prepared in accordance with the W-521 estimating standards including site adds, labor rates and burden. Based on the estimates and the merits of the options, a preferred option was selected, using engineering judgment and rough order of magnitude cost estimates.

3.4 Discussion

The condensate drain from 241-AZ-702 must be rerouted to another destination after the catch tank is removed from service. The problem definition is compounded by two operational requests/problems.

- The first is the desire to route the 241-AZ-702 condensate to any of the four of the 241-AY and 241-AZ tanks. Although the flow rate of condensate is very low (0.15 to 0.30 gpm), it is felt that over time a sufficient quantity of liquid could collect in a particular 241-AY or 241-AZ tank such that ongoing characterization of that tank may be effected. The obvious solution is to have the ability to direct flow to a 241-AY or 241-AZ tank whose characterization is not ongoing. This implies having the ability to direct flow to any of the four tanks.

- The current seal pot located within 241-AZ-702 has had problems with level control and loss of seal. The cause of the problem is not known.

Two options have been identified to address the condensate routing. However, only the second option addresses both the condensate routing and the condensate seal pot issues.

Option 1. With this option, a compliant Catch Tank and Lift Station is installed to allow collection of the 241-AZ-702 condensate with the capability to pump the condensate to any of the four tanks. This option is shown in Sketches ES-LS-01 and ES-LS-02 (See Appendix B). The Lift Station will be level switch operated with manual remote-operated valves to direct flow from the pump discharge to any of the four tanks. There will be an overflow line that will provide a gravity drain directly to AZ-102. This option addresses the ability to direct condensate into any of the four tanks, but does not address the seal pot operational problems.

Option 2. This option modifies the existing drain configuration within the 241-AZ-702 building. This option is shown in Sketches ES-SP-01 and ES-SP-02 (See Appendix B). The design will replace the existing seal pot with a larger vessel that will include a level actuated pump. The pump will discharge into a manual, remote-operated valve manifold that will direct flow to any of the four tanks. There will be a high level drain that will flow by gravity to 241-AZ-102. This option addresses both the seal pot operational problems and the discharge flow routing.

3.5 Conclusions and Recommendations

The recommended approach is Option 2. The rationale behind this recommendation is threefold. One, the cost of Option 2 is less than the cost of Option 1. Two, the modification to the existing system solves both of the operational concerns. Three, the solution does not require the installation of another underground storage tank, thus reducing the cost of maintaining and ultimately decommissioning the system.

4.0 SUBTASK 3: INCREASING ANNULUS VENTILATION FLOW

4.1 Purpose

Design requirements for the DST Ventilation Systems are contained in CHG (2000a). This document, released after completion of the CDR, specifies that the annulus ventilation systems shall provide a minimum airflow of 850 cfm through the air slots of the 241-AY and 241-AZ tanks. Currently, the 241-

AY and 241-AZ annulus ventilation systems do not provide this flow rate (Tank 241-AY-102 is an exception; Project W-320 modified that tank's system to provide such a flow rate).

This task considers two options to achieve the required flow rate through the 241-AY and 241-AZ tanks. In one, each system employs a single exhaust fan to draw air through the tank annulus. In the other, two fans, supply and exhaust, are used to move air through the annulus.

4.2 Scope

The scope of this activity includes modifications that will increase the airflow through the annulus air slots of the 241-AY and 241-AZ tanks. This activity does not consider modifications that would bring this existing system into full compliance with CHG (2000a). Rather, only those modifications required to achieve the higher flow rates will comply with the requirements of CHG (2000a).

4.3 Methodology

Two options were developed that would provide the required flow rate. The merits of each option were considered and a preferred option selected. Sketches of the preferred option were prepared showing the mechanical, electrical and control equipment necessary to implement the option. A cost estimate was then prepared based on the sketches.

4.4 Discussion

With the single-fan option, a single exhaust fan is located downstream of the tank and draws air through the annulus. This configuration is consistent with the design of the existing systems and requires only minor changes to implement as compared with the two-fan option. Project W-320 used this concept to achieve a similar flow rate through the air slots of the 241-AY-102 annulus.

With the two-fan option, the two fans work together to move air through the annulus. One fan supplies air to the annulus while a second fan withdraws the air from the annulus. This option adds a new component to the existing system, namely, the fan supplying air to the annulus.

4.4.1 Single Fan Option

The single fan option is the simpler and more cost effective approach of the two options. To implement this option, two changes are required. The existing fans are replaced with fans capable of generating a greater static pressure. Also, the piping is modified so the entire air stream passes through the annulus slots (with the original design, only 20 percent of the air stream passed through the air slots; 80 percent of the air bypassed the slots and directly entered the annulus tank at the sidewall).

While these modifications are simple to implement (as compared to the second option), this option suffers from a potential problem. Project W-320 successfully used a single fan to obtain 850-1000 cfm of airflow through the air slots of tank 241-AY-102. However, Project W-320 experienced annulus pressures in the range of –15 to –16-in. (w.g.) when operating in this configuration (Numatec, 1998). This range exceeds the requirements of CHG (2000a). While the requirements of this document do not limit the annulus pressure directly, they do limit the difference between the primary and annulus pressures. As described in CHG (2000a), the difference in two pressures shall not exceed 6-in. (w.g.). At the time that W-320 collected its data, the pressure difference between the primary tank and annulus tank was 13 to 14-in. (w.g.).

To limit the annulus pressure to a more suitable range, modifications are required to the piping of the annulus systems. To successfully plan these modifications, the pressure loss through the annulus ventilation system must be calculated. Unfortunately, the pressure change through the air slots is unknown. A calculation was prepared (shown as Appendix E) to determine the pressure drop through the air slots. The results of the calculation were then compared with operating data collected from tank 241-AY-102 in January of 1998, (Numatec, 1998). The actual losses through the system greatly exceeded the calculated losses. At a flow rate of approximately 1000 cfm, the annulus pressure of tank 241-AY-102 was observed operating at a pressure of approximately 15.5-in. (w.g.). The pressure predicted by calculation was approximately half this value or 8.7-in. (w.g.). The most likely explanation for this disparity is a restriction of the flow path through the air slots. In the past, questions have been raised as to the integrity of the concrete under the tank. It has been hypothesized that the concrete has cracked, spalled or otherwise deteriorated to the point that the original air slots now contain debris. This would result an annulus pressure more negative than expected.

The inability to predict the system's pressure loss makes this option unattractive. The narrow range of allowable annulus pressures further complicates this problem. Due to the risk of this approach, the option of a single exhaust fan is not recommended for Project W-521.

4.4.2 Two Fan Option

The second method of achieving 850-1000 cfm employs two fans. This method achieves the required flow while allowing control of the annulus pressure. Furthermore, this method can be implemented so the system has a large amount of flexibility to overcome uncertainties in the flow path.

With this option, supply fans are added to the existing systems. Furthermore, variable speed drives are connected to both the supply and exhaust fans. By adjusting the speeds of the fan, the parameters of flow rate and annulus pressure can be controlled independently.

4.4.3 Implementation of the Preferred Option for 241-AY

Two independent systems currently ventilate the 241-AY annulus tanks. One system ventilates the 241-AY-101 tank, while a second, separate system ventilates the 241-AY-102 tank. Conceptually, both systems are identical; both consist of an inlet filter plenum, an exhaust filter plenum and a fan. Ancillary equipment includes leak detection Continuous Air Monitor (CAMs), a stack CAM and heaters. Implementing this option requires adding a supply fan between the inlet filter plenum and the piping that leads to the tank annulus. Variable frequency drives modulate the speed of the exhaust and supply fan. A control loop employing a Programmable Logic Controller (PLC) monitors the annulus pressure and the system flow rate. The control loop then adjusts each fan's speed as necessary to maintain the system's operation within its design requirements.

Sketches ES-AY-01 through ES-AY-04 (Appendix C) identify what modifications are necessary to implement this option for the 241-AY tanks. These modifications include replacing the existing exhaust fans with new models whose performance will be more consistent with the new supply fans.

With this design, a wide range of annulus pressures is achievable [between 0 and –20-in. (w.g.)]. However it is recommended that the annulus pressure be controlled between –6 and –8-in. (w.g.). This pressure is less than the least allowable pressure within the primary tank [reference HNF-SD-WM-SAR-067, Rev. 1F, *Tank Waste Remediation System Final Safety Analysis Report* (CHG 2000b)] and will allow the system to operate as originally designed (i.e., a greater pressure in the primary tank than in the annulus tank).

4.4.4 Implementation of the Preferred Option for 241-AZ

A single system ventilates the 241-AZ-101 and the 241-AZ-102 tanks. The system currently consists of a common inlet filter plenum, two exhaust filter plenums (one for each tank), and a common exhaust fan. Ancillary equipment includes balancing valves (that distribute air between the air slots and the annulus side walls), leak detection CAMs, a stack CAM and heaters. Implementing this option requires installing a fan between the common inlet filter plenum and the piping junction that leads to each of the tanks. Variable frequency drives modulate the speed of the supply and exhaust fans. A control loop employing a PLC monitors the annulus pressure of both tanks and the system flow rate. The control loop then adjusts each fan's speed as necessary to maintain the system's operation within its design requirements. Throttling valves are manually adjusted to achieve similar pressures in each tank annulus should one tank's flow path prove to have a greater pressure loss than the other tank's flow path. As with the 241-AY tanks, it is recommended that the control loop maintain the annulus pressure within the range of –6-in. (w.g.) to –8-in. (w.g.). Doing so will restore the system to its original configuration (i.e., a greater pressure in the primary tank than in the annulus tank).

Sketches ES-AZ-01 through ES-AZ-04 (Appendix D) identify what modifications are necessary to implement this option for the 241-AZ tanks. These modifications include replacing the existing exhaust fans with new models whose performance will be more consistent with the new supply fans. These modifications also include refurbishing some portions of the existing system. The modifications will replace the inlet filter plenum with a new plenum. The existing inlet filter plenum is plugged to the point that it is unusable and the plenum's older design does not allow replacement of the filter media alone. The modifications replace the tank balancing valves whose integrity is questionable. The modifications also replace the exhaust filter plenums with new plenums that allow testing against the requirements of ASME N510. Furthermore, the modifications upgrade the leak detection CAMs. Although this last modification is unnecessary to achieve the required flow rates, upgrading these CAMs will return these safety-class components to service. The modifications do not replace the underground piping leading to and from the tank. However, the integrity of this piping should be confirmed before proceeding with these modifications. It is recommended that a portion of the piping be visually examined both internally and externally. At the same time, ultrasonic testing should be performed to measure the remaining wall thickness of the pipe.

4.5 Conclusions and Recommendations

The preferred option for obtaining 850-1000 cfm through the sir slots is the second option that combines a supply fan with the existing exhaust fan. This option will provide a robust design that can overcome uncertainties in the conditions of the air slots. Furthermore, the option allows the annulus pressure to be controlled to a wide range of pressures (the annulus pressure can be adjusted so it is greater or smaller than the primary tank pressure depending upon the desires of the operator).

5.0 SUBTASK 4: COMPLIANCE WITH THE VENTILATION SPECIFICATION

5.1 Purpose

This activity reconciles the design requirements in the CHG (2000a) with the system modifications presented in the CDR (CHG 2000c). This activity is necessary because the Conceptual Design was completed before design requirements were finalized and released.

5.2 Scope

This activity is applicable only to the Project W-521 modifications of the 241-AZ-702 Primary Tank Ventilation System. The specific ventilation system modifications that are in the scope of Project W-521 are identified in the CDR (CHG 2000c). Components and subsystems that are not being redesigned by project W-521 are not in the scope of this activity.

This activity does not directly apply to the 241-AY and 241-AZ annulus ventilation systems. These systems were not modified in the CDR. While Project W-521 had planned to refurbish these systems (thereby returning them to active service), the project did not intend to redesign the systems. Since the systems were not redesigned, the design requirements of CHG (2000a) were not imposed on these existing systems. Future activities during Definitive Design that alters the design of these systems will comply with design requirements of CHG (2000a).

5.3 Methodology

The Project W-521 ventilation system modifications were compared to applicable requirements in HNF-5196 and compliance to those requirements determined. The specific ventilation system components and subsystems within the scope of Project W-521 are identified in Section 2.2.9 of the CDR (CHG 2000c). A requirement was considered applicable if it was directly or indirectly related to a component or subsystem being modified or replaced by the project.

The requirements were grouped into three categories: 1) requirements that were explicitly met by the Conceptual design; 2) requirements that were not explicitly met by the Conceptual Design but will be met during Definitive Design; and 3) requirements that will not be met in either the Conceptual or Definitive Design. The requirements associated with the second and third groups are listed in Table 5-1. Specific and detailed requirements are included in CHG (2000a). General actions necessary to ensure compliance with the requirements are identified also in Table 5-1.

5.4 Discussion

The evaluation of Project W-521 ventilation system modifications identified one requirement in CHG (2000a) that may not be met by the proposed changes to the primary exhaust ventilation system. The 241-AZ-702 ventilation system provides primary tank ventilation for all four aging waste tanks in the 241-AY and 241-AZ tank farms. The 241-AZ-702 ventilation system draws approximately 150 cfm through each of the four tanks (600 cfm total) during normal operations. The system is capable of drawing approximately 500 cfm through one tank while drawing 150 cfm through the three other tanks. Section 3.2.1.1.5.a of CHG (2000a) requires drawing 500 cfm of air through any tank with an operating mixer pump. Therefore, this requirement cannot be satisfied if mixer pumps in the 241-AY and 241-AZ tank farms are operated simultaneously.

5.5 Conclusions and Recommendations

The CDR (CHG 2000c), which completed in July 2000, does not comply with the design requirements of CHG (2000a). Upon implementation of the actions identified herein, compliance with the design requirements for the scope assigned to W-521 will be achieved. However, one potential issue exists. Although not explicitly required, mixer pumps in only one tank can be operated at any given time. Therefore, mixer pumps cannot be operated in both the 241-AY and 241-AZ tank farms at any given time. CHG (2000a) does not require simultaneous operation of mixer pumps in two farms. However, this limitation may lead to scheduling conflicts as waste is staged and moved through the 241-AY and 241-AZ tank farms.

6.0 OVERALL RECOMMENDATIONS

The overall conclusions related to each of the activities are as follows:

6.1 Technical Recommendations

- The Primary Ventilation System should have an increased maintenance effort placed on it, and should support all RPP goals without significant upgrades.
- The routing of condensate to each of the AY/AZ Tanks is appropriate and necessary, and should be implemented in the manner shown in this report.
- The AY/AZ Annulus Ventilation System should be upgraded through the addition of the two fan option.
- The Ventilation System upgrades recommended by this activity should be (and can be) installed in compliance with the Level 2 Specifications.

Table 5-1. Deviations of the W-521 Conceptual Design from the Requirements of CHG (2000a).

HNF-5196 Section	Requirement	Compliance	Compliance Actions
Requirement Not Met			
3.2.1.1.5.a	Primary ventilation subsystems shall be capable of providing an individual tank flow rate of 14.2 m^3/min (500 ft^3/min standard) when the mixer pumps are operating, to ensure that applicable temperature limits can be met.	Not Met	The 702-AZ Ventilation System does not have adequate capacity to provide the required flow rate for both the 241-AY and 241-AZ tank farms. To provide the minimum flow in both 241-AY and 241-AZ tank farms, major components (fans, filters, piping, etc.) may require replacement.
Requirement Will Be Met during Definitive Design			
3.2.1.1.3.a	The subsystem shall monitor radioactive emissions in accordance with the requirements of Sections 2.1 and 2.2 *Air Quality - Radioactive Emissions*, RPP-PRO-450.	Will Be Met	In addition to the new shrouded probe, the Definitive Design will ensure that radioactive emissions are monitored according to current requirements. Upgrades will conform to RPP-PRO-450.
3.2.1.1.3.b	The subsystem shall sample radioactive air emissions in accordance with Sections 2.7, 2.9, 2.11, 2.12, 2.13, and 2.14 of *Radioactive Airborne Effluent Sampling*, RPP-PRO-2364.	Will Be Met	In addition to the new shrouded probe, the Definitive Design will ensure that radioactive air emissions are sampled according to current requirements. Upgrades will conform to RPP-PRO-450.
3.2.5.2.3.a	The subsystem shall meet the requirements specified in ASME N509, Sections 5.6.4.2, 5.6.4.3, 5.6.4.4, and 5.6.4.5.	Will Be Met	Definitive design will ensure that new SSCs comply with ASME N509 material requirements.
3.3	The DST Ventilation Subsystem shall comply with DOE order 6430.1A, Sections 1300-7 and 1323.	Will Be Met	Definitive design will ensure that new SSCs comply with applicable DOE 6430.1A confinement requirements.
3.3.1.1a	The subsystem shall be designed per *Code of Nuclear Air and Gas Treatment*, ASME AG-1; ASME N509; and *Testing of Nuclear Air Treatment Systems*, N510 requirements.	Will Be Met	Upgrades will be designed according to ASME AG-1, N509, and N510.
3.3.1.1.f	The subsystem shall maintain the flow velocity through the stack outlet at $\geq$ 610 m/min (2,000 ft/min).	Will Be Met	Adequate stack velocity will be considered during Definitive Design when replacement exhaust fans are selected.
3.3.1.2.a	All primary and annulus ventilation condensate drain lines shall be designed, fabricated, and inspected per *Process Piping*, ASME B31.3.	Will Be Met	New condensate drain lines will be designed, fabricated, and inspected per ASME B31.3.
3.3.1.2.b	The condensate drainage piping shall be fabricated from 300 series stainless steel material and shall be of welded construction.	Will Be Met	New condensate drain lines will be 300 series stainless steel and all welded construction.
3.3.1.4.a	The centrifugal exhaust fans shall be designed and constructed to meet requirements of ASME N509, ASME AG-1; AMCA 99-0200.	Will Be Met	Replacement fans will conform to ASME N509, ASME AG-1; AMCA 99-0200 requirements.
3.3.1.4.b	The subsystem shall be certified and meet the requirements of *Laboratory methods of Testing Fans for Aerodynamic Performance Rating*, AMCA 210, for exhaust fan performance.	Will Be Met	The procurement specification for exhaust fans will require fans to be certified per AMCA 210.
3.3.1.4.c	The exhaust fans shall be equipped with gravity back-draft dampers to prevent back draft through the fan while the fan is in standby mode.	Will Be Met	The procurement specification for exhaust fans will require gravity back-draft dampers.
3.3.1.4.e	The subsystem shall provide shaft seals for each fan to reduce in-leakage to a minimum.	Will Be Met	The procurement specification for exhaust fans will require shaft seals.
3.3.1.4.f	The exhaust fan/motors shall be in compliance with ASME N509, Section 5.8, "Fan Drives," and ASME AG-1, Section BA-4324, "Electrical Design Requirements."	Will Be Met	Replacement fans/motors will conform to ASME N509 and ASME AG-1 requirements.

6.2 Cost Recommendations

The overall cost impact of this effort on the CDR Estimate is as shown below:

- Primary Ventilation Modification

PRIMARY VENTILATION SYSTEM AZ-702 REDUCTION FROM CDR ESTIMATE												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$2,012,678	-$673,396	-$996,083	-$184,108	-$920,539	-$303,778	-$62,597	-$441,859	-$184,108	-$936,714	-$1,186,552	-$1,833,464	-$9,735,876

- Condensate Routing Modification

CONDENSATE MODIFICATIONS- TOTAL REDUCTION FROM CDR ESTIMATE												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$693,245	-$74,876	-$266,768	-$51,745	-$258,723	-$85,379	-$17,593	-$124,186	-$51,745	-$258,090	-$347,577	-$523,766	-$2,753,693

- Annulus System Modification

ANNULUS MODIFICATIONS FOR AY FARM AND AZ FARM - ADDITION TO CDR ESTIMATE												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
$798,390	$316,107	$389,653	$75,208	$376,038	$124,093	$25,571	$180,498	$154,927	$391,245	$508,827	$766,760	$4,107,317

7.0 REFERENCES

CHG 2000a, *Double-Shell Tank Ventilation Subsystem Specification*, HNF-5196, Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

CHG 2000b, *Tank Waste Remediation System Final Safety Analysis Report*, HNF-SD-WM-SAR-067, Rev. 1F, CH2M Hill Hanford Group, Inc., Richland, Washington.

CHG 2000c, *Project W-521 Waste Feed Delivery System Conceptual Design Report*, RPP-6333, Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

Numatec 1998, *Project W-320 High Vacuum 241-AY-102 Annulus Ventilation System Operability Test Report*, HNF-2317, Rev. 0, Numatec, Richland, Washington.

Appendix A
Alternative Generation and Analysis for the AY/AZ Primary Ventilation System AZ-702

ALTERNATIVE GENERATION AND ANALYSIS FOR THE AY/AZ PRIMARY VENTILATION SYSTEM AZ-702

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Release 46
Report No. 990920203-019
ACDR Subtask 3
Revision 0

September 2000

prepared by

HND TEAM

ALTERNATIVE GENERATION AND ANALYSIS FOR THE AY/AZ PRIMARY VENTILATION SYSTEM AZ-702

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September 2000

Prepared by: Larry E. Shipley, P.E.
Scott R. Pierce, P.E.

Approved by: RLFritz
Robert L. Fritz

Date: 9-21-00

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Acronyms

ACD	Advanced Conceptual Design
AGA	Alternative Generation and Analysis
CD	Conceptual Design
CTB	Cost-To-Benefit
DST	Double-Shell Tanks
HEME	High Efficiency Mist Eliminator
MTTF	Mean Time to Failure

1.0 INTRODUCTION

1.1 Scope

There are two types of ventilation systems associated with the AY 241-101 & 102, and AZ 241-101 & 102 Double-Shell Tanks (DST). These ventilation systems are used to remove waste heat, to purge the tank of generated gases, and to maintain negative pressure in the tank and annulus. The Annulus Ventilation Systems are used to ventilate the annular space between the primary and secondary tank walls. The primary ventilation system consists of individual recirculation / cooling loops for each tank and one exhaust system for all four tanks. This Alternative Generation and Analysis (AGA) is associated with the primary system and specifically with those components contained within Building AZ-702.

During the Conceptual Design (CD) for Project W-521, "Waste Feed Delivery," a regulatory interpretation caused a fully redundant train of the primary ventilation process equipment and ducting to be provided for risk mitigation. Due to limited space within AZ-702, this additional equipment required that an annex to the existing AZ-702 be provided to house that equipment. This revision to the primary ventilation system was captured in equipment layout drawings and in the cost estimate provided in the CDR.

Since the completion of the CD, the regulatory requirement for a fully redundant train has been reevaluated. As a part of the Advanced Conceptual Design (ACD), this AGA was prepared to assess the reliability of the primary ventilation system relative to its ability to support waste transfer to the vitrification facility, and recommend the minimum upgrades to reliably achieve this goal. The assessment included a cost-to-benefit (CTB) analysis of the addition certain components that are redundant. The cost incurred was for the addition of redundant components while the benefit received was due to the increased reliability provided by the redundancy. Using Mean Time to Failure (MTTF) data, the improvement in the probability of failure was determined.

Cost estimates were developed to support the CTB for the base case and the three options. There are interactions between these costs developed for this AGA and the estimates that are developed in conjunction with the AZ-702 condensate drain rerouting and the modifications included in the CDR.

The following sections describe the execution of this analysis and present the results.

1.2 Methodology

The CTB analysis performed for this AGA required that the options to be used in the study be established; the system fault trees be developed; the failure rates for the ventilation system components be determined; the system failure probabilities propagated through the system fault trees, and the cost for implementation of each of the options be estimated. The evaluation and recommendations includes an examination of the base case reliability with enhanced maintenance.

2.0 DEFINITIONS

Vitrification Facility – The facility where tank waste will be processed and placed in a stable, glassified form for interim storage.

Cost-to Benefit – The relationship between the life-cycle cost to maintain or add a system or component and the ultimate benefit (in this case reliability improvement) received.

Double Shell Staging Tanks – An existing DST to be used for preparing waste for transfer to the vitrification facility.

3.0 PROBLEM DEFINITION

Transfer from the AY/AZ, double shelled staging tanks, to the vitrification facility is directly dependent on continual operation of the primary ventilation system and specifically those components contained within AZ-702. The components on the tank inlet and the tank outlet (ducting, louvers, filters, dampers, etc) up to AZ-702 facility are passive components and not subject to the reliability considerations developed within this report. It should be noted that the use of the recirculation loop components at each AY/AZ tank outlet should not be required during the time of transfer and, in any case, are beyond the scope of this AGA.

The primary ventilation system must function during a transfer. If it does not, the transfer will be ceased. Increased reliability of the AZ-702 components will increase the probability that each transfer will be successful, or conversely, that the probability of failure will be lower. This increase in reliability may be obtained through the addition of redundant components, albeit at the penalty of increased project cost.

4.0 ALTERNATIVE ANALYSIS

A CTB evaluation technique is employed to evaluate the options available to improve reliability of the primary ventilation system (AZ-702). The technique employed is described in the following steps:

4.1 Determination of Options

Various alternatives that would increase the primary ventilation system reliability were reviewed. It was determined that the addition of redundant components was the best method of increasing system reliability.

Three options have been established along with the base case (existing configurations) that are described in Table 4-1. The base case represents those components that are required by the air permit for operation but are non-redundant in their current configuration. Those components are the High Efficiency Mist Eliminator (HEME), Condenser, and Chiller. The base case includes one HEME, one

Condenser, and one Chiller. Drawings/sketches depicting the existing configuration can be found in Appendix C.

Option 1 adds a redundant HEME, piping, ducting, valving, and appropriate instrumentation to the base case. The new equipment will be located within the existing structure. Modifications to the roof will be necessary in order to accommodate maintenance access. Drawings and sketches depicting the configuration of Option 1 can be found in Appendix C.

Option 2 adds a redundant chiller unit to the configuration discussed for Option 1. The redundant chiller will be located adjacent to the existing unit with the Glycol lines connecting to the existing lines. Drawings/sketches of this configuration can be found in Appendix C.

Option 3 adds a fully redundant train in a new AZ-702 building annex. This layout represents the configuration described within the CDR. This configuration requires that the AZ-702 Building be expanded to house the equipment. For this option, the chiller unit is relocated from the Option 2 configuration to be in closer proximately to the new condenser. Drawings and sketches for Option 3 can be found in Appendix C.

Table 4-1. Primary Ventilation System Configuration Options

Options	HEME	Condenser	Chiller	Building	
				Existing	New Annex
Base	1	1	1	X	
1	2	1	1	X	
2	2	1	2	X	
3	2	2	2	X	X

4.2 Development of Option System Fault Trees

System Fault Trees were generated for the base case and each option. Failure mechanisms were determined for of each of the major components that would cause a primary ventilation system shut down. Fault Tree "AND/OR" gates were established (along with end-states) to describe the fully developed fault trees. The system fault trees for each of the options are in Appendix A. System Fault Trees were generated using the commercial software ARRAMIS and were evaluated in EXCEL.

4.3 Development of Equipment Failure Probabilities

Component failure rates were obtained whenever possible from the nationally recognized source, NPRD-95, *Non-Electronic Port Reliability Data* (NPRD 1995). In some instances, failure rates could not be obtained from this source and, in these cases, engineering judgment was used while considering operating experience at Hanford. The Basis Event Failure Rate Data can be found in Table 4-2.

There are two failure rates provided:

✓ Failure / Hr – this is from the data described

✓ Failure / Transfer – this number is derived from the assumption that a transfer can continue for up to a week and hence, the Failure per Transfer is Failure per hour x Hours per Transfer = Failure per transfer.

Table 4-2. Basic Component Failure Rate Data.

Basic Event	Probability / hr	Probability / transfer	Reference
Chiller Electrical Fails	3.00E-06	5.04E-04	NPRD-95, Pages 2-84 and 2-38
Chiller Mechanical Fails	2.00E-05	3.36E-03	NPRD-95, Page 2-35
Chiller Control Fails	2.00E-06	3.36E-04	NPRD-95, Page 2-67
Condenser Tube Leak	5.00E-06	8.40E-04	NPRD-95, Page 2-48
Glycol Line Leak	1.00E-06	1.68E-04	NPRD-95, Page 2-150
Ducting Fails	1.00E-06	1.68E-04	NPRD-95, Page 2-67 (ducting used was pipe)
HEME Catastrophic Failure	1.00E-05	1.68E-03	Engineering Judgment
Condensate Line Plugs	1.00E-06	1.68E-04	Engineering Judgment
Information: 1. Catastrophic failure of HEME refers to failure of the internal mesh. 2. Probabilities are in failures/hr. Probability of a failure/transfer assumes a one week (168 hour) transfer period			

4.4 Development of the System Probability of Failure per Transfer

Using the fault trees developed in section 4.2 and the equipment failure rate data developed in section 4.3, the probability of failure for the base case and each option for loss of system function is calculated. The detailed results of these calculations can be found in Appendix B. Table 4-3 includes is a summary of those results.

Table 4-3. Summary Results.

System	Probability of Failure per Transfer	Probability of Success per Transfer	MTTF (in weeks)	Increased Costs
Base Case	7.2 x 10-3	0.9928	139	$0.00
Option 1	5.4 x 10-3	0.9946	185	$1.801 M
Option 2	1.0 x 10-3	0.9990	970	$2.679 M
Option 3	2.0 x 10-4	0.9998	5050	$7.948 M

The results in Table 4-3 are graphed in Figure 4-1 showing the decrease in probability of ventilation system failure per transfer as a function of the increased costs for each option. Thus, the results in Figure 4-1 show the cost versus benefit (reduced ventilation system failure per transfer) for each option.

4.5 Development of Cost Estimates

The base case assumes that no modifications to the existing facility will be required, hence, there is no additional cost. Detailed cost estimates that are used in the CTB analysis were developed for each Option. Option 1 utilizes the existing AZ-702 building structure in which to locate the redundant equipment (HEME) and associated ducting and valves. Option 2 includes the costs of Option 1 and an additional chiller, which is, located outside the AZ-702 building envelope. Neither Option 1 nor 2 requires modification to the existing structures. The estimate for Option 3 includes the costs associated with the new AZ-702 annex and fully redundant train of equipment. The labor rates, site adds escalation and contingency rely on the same assumptions as were used in the CD cost estimate. A summary of the cost estimate increases above the base case is provided in Table 4-3, and the detailed cost data may be found in Appendix D, of Attachment C, Appendix A.

4.6 Additional Maintenance Prior to a Transfer

If routine maintenance were to be performed on the ventilation system several weeks prior to each waste transfer, and the system restarted to allow sufficient time to observe maintenance errors, significant improvements in system reliability can be achieved. The basis for this reliability improvement is the fact that the system base case has a MTTF of approximately 139 weeks. Thus, performing routine maintenance a couple of weeks before a waste transfer would restore the system to near 139 week MTTF. Thus, the system base case MTTF would be improved from a 87 (189 – 52) week (worst case) MTTF back to a 139 week MTTF. This improvement would be achieved at some cost, but one that is insignificant compared to the other options.

4.7 Uncertainty

The uncertainty associated with this evaluation will be addressed by bounding both the cost and failure probabilities in Figure 4-1. The cost uncertainty will be expressed as 10% of the Option cost estimate, while the total uncertainty in the failure probability will be expressed as an order of magnitude for each Option. The uncertainty in the cost estimate is taken to be within the normal range of estimating accuracy for a project of this type, i.e. modifications to a system within an existing structure. The uncertainty approximation in the system failure probability represents the assumed uncertainty associated with the failure rate of each component propagated through the system fault tree.

The use of this uncertainty analysis approach allows one to visualize the region of space around each cost to benefit point value in Figure 4-1 within which the correct answer most probably resides.

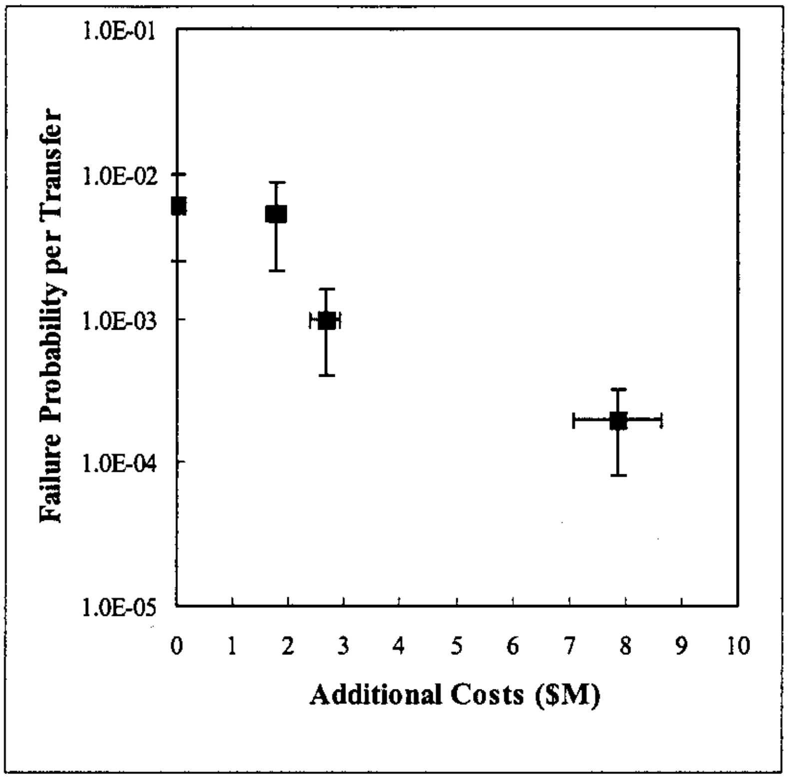

Figure 4-1. Failure Probabilities per Transfer as a Function of the Additional Costs.

5.0 SUMMARY

Figure 4-1 provides the results of the CTB evaluation. A brief examination of the base case shows us with the zero additional expenditure, the probability of failure of the primary system is 7.2x10-3 during any transfer, where a transfer is considered to last for one week. Said differently, the information indicates that the system could most likely operate successfully for 139 weeks without failure (i.e., the MTTF is 139 weeks). This then becomes the standard against which the options and this cost should be judged.

Option 1 indicates that by adding a HEME at a cost of $1.804 M, an improvement in the failure probability to 5.38E-03 per transfer is achieved. This equates to 185 weeks as the MTTF for this option.

Option 2 adds a HEME and a chiller at a cost of $2.679 M and achieves an improvement in the failure probability to 1.03E-03 per transfer or a MTTF of 970 weeks.

Option 3 adds a HEME, a chiller, a condenser, and a building annex at a cost of $7.948 M and achieves an improvement in the failure probability to 1.98E-04 per transfer or a MTTF of 5050 weeks.

6.0 RECOMMENDATIONS

An examination of the summary data provided in section 5.0 demonstrates that the base case has substantial margin against failure, i.e. one-week operational requirement versus 139 weeks as a MMTF. This fact taken alone would indicate that additional improvements in the probability of failure should not be necessary.

Additional margin can be obtained by performing the periodic maintenance on the system components just prior to a transfer. The amount of maintenance and the cost of this maintenance should be evaluated during the Title design and a decision made at that time as to the necessity to perform this maintenance.

The data further indicates that the minor improvement in the probability of failure (a difference in the MTTF of 46 weeks) versus the cost for Option 1 (additional HEME) does not speak well for the choice of this option in any case. A similar case can be made for Options 2 and 3.

It is recommended to continue with the existing system and investigate increased maintenance during DST staging/transfer operations.

7.0 REFERENCES

NPRD 1995, *Non-Electronic Port Reliability Data,* NPRD-95, Reliability Analysis Center of Rome, New York.

Appendix A
Fault Trees

```
^1                  Failure of Condenser/HEME Cause Loss of Exhaust Ventilation
├─ 11                 Condenser Fails
│  ├─ 111               Chiller Fails
│  │  ├─ 1111             Chiller Electrical Fails
│  │  ├─ 1112             Chiller Mechanical Fails
│  │  └─ 1113             Chiller Controls Fail
│  ├─ 112               Condenser Tube Leak
│  └─ 113               Glycol Lines Fail
├─ 12                 Ducting Fails
└─ 13                 HEME Fails
   ├─ 131               Condensate Line Plugs
   └─ 132               HEME Catastrophic Failure
```

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^1              Failure of Condenser/HEME Cause Loss of Exhaust Ventilation
  11              Condenser Fails
    111             Chiller Fails
      1111            Chiller Electrical Fails
      1112            Chiller Mechanical Fails
      1113            Chiller Controls Fail
    112             Condenser Tube Leak
    113             Glycol Lines Fail
  12              Ducting Fails
  13              Redundant HEMEs Fail
    131             HEME System 1 Fails
      1311            HEME 1 Catastrophic Failure
      1312            Condensate Line 1 Plugs
      1313            HEME Duct 1 Fails
    132             HEME System 2 Fails
      1321            HEME 2 Catastrophic Failure
      1322            Condensate Line 2 Plugs
      1323            HEME Duct 2 Fails
```

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- ^1 Failure of Condenser/HEME Cause Loss of Exhaust Ventilation
  - 11 Condenser Fails
    - 111 Redundant Chillers Fail
      - 1111 Chiller 1 Fails
        - 11111 Chiller 1 Electrical Fails
        - 11112 Chiller 1 Mechanical Fails
        - 11113 Chiller 1 Controls Fail
        - 11114 Glycol Line 1 Fails
      - 1112 Chiller 2 Fails
        - 11121 Chiller 2 Electrical Fails
        - 11122 Chiller 2 Mechanical Fails
        - 11123 Chiller 2 Controls Fail
        - 11124 Glycol Line 2 Fails
    - 112 Condenser Tube Leak
  - 12 Ducting Fails
  - 13 Redundant HEMEs Fail
    - 131 HEME System 1 Fails
      - 1311 HEME 1 Catastrophic Failure
      - 1312 Condensate Line 1 Plugs
      - 1313 HEME Duct 1 Fails
    - 132 HEME System 2 Fails
      - 1321 HEME 2 Catastrophic Failure
      - 1322 Condensate Line 2 Plugs
      - 1323 HEME Duct 2 Fails

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^1                    Failure of Condenser/HEME Cause Loss of Exhaust Ventilation
  11                    Redundant Condensers Fail
    111                   Condenser 1 Fails
      1111                  Chiller 1 Fails
        11111                 Chiller 1 Electrical Fails
        11112                 Chiller 1 Mechanical Fails
        11113                 Chiller 1 Controls Fail
      1112                  Condenser 1 Tube Leak
      1113                  Glycol Line 1 Fails
      1114                  Condenser 1 Duct Fails
    112                   Condenser 2 Fails
      1121                  Chiller 2 Fails
        11211                 Chiller 2 Electrical Fails
        11212                 Chiller 2 Mechanical Fails
        11213                 Chiller 2 Controls Fail
      1122                  Condenser 2 Tube Leak
      1123                  Glycol Line 2 Fails
      1124                  Condenser 2 Duct Fails
  12                    Ducting Fails
  13                    Redundant HEMEs Fail
    131                   HEME System 1 Fails
      1311                  HEME 1 Catastrophic Failure
      1312                  Condensate Line 1 Plugs
      1313                  HEME Duct 1 Fails
    132                   HEME System 2 Fails
      1321                  HEME 2 Catastrophic Failure
      1322                  Condensate Line 2 Plugs
      1323                  HEME Duct 2 Fails
```

Appendix B
System Failure Probability Per Transfer

Table B.1. Failure Probability per Transfer for the Base Case.

Event No.	Description	Probability
1	Failure of Condenser / HEME Causes Loss of Exhaust Ventilation	7.22E-03
11	Condenser Fails	5.21E-03
111	Chiller Fails	4.20E-03
1111	Chiller Electrical Fails	5.04E-04
1112	Chiller Mechanical Fails	3.36E-03
1113	Chiller Controls Fail	3.36E-04
112	Condenser Tube Leaks	8.40E-04
113	Glycol Lines Fail	1.68E-06
12	Ducting Fails	1.68E-04
13	HEME Fails	1.85E-03
131	Condensate Line Plugs	1.68E-04
132	HEME Catastrophic Failure	1.68E-03
Probability is the probability of a failure per transfer		

Table B.2. Failure Probability per Transfer for the Option 1.

Event No.	Description	Probability
1	Failure of Condenser / HEME Causes Loss of Exhaust Ventilation	5.38E-03
11	Condenser Fails	5.21E-03
111	Chiller Fails	4.20E-03
1111	Chiller Electrical Fails	5.04E-04
1112	Chiller Mechanical Fails	3.36E-03
1113	Chiller Controls Fail	3.36E-04
112	Condenser Tube Leaks	8.40E-04
113	Glycol Lines Fail	1.68E-04
12	Ducting Fails	1.68E-04
13	HEME Fails	4.06E-06
131	HEME System 1 Fails	2.02E-03
1311	HEME 1 Catastrophic Failure	1.68E-03
1312	Condensate Line 1 Plugs	1.68E-04
1313	HEME Duct 1 Fails	1.68E-04
132	HEME System 2 Fails	2.02E-03
1321	HEME 2 Catastrophic Failure	1.68E-03
1322	Condensate Line 2 Plugs	1.68E-04
1323	HEME Duct 2 Fails	1.68E-04
Probability is the probability of a failure per transfer		

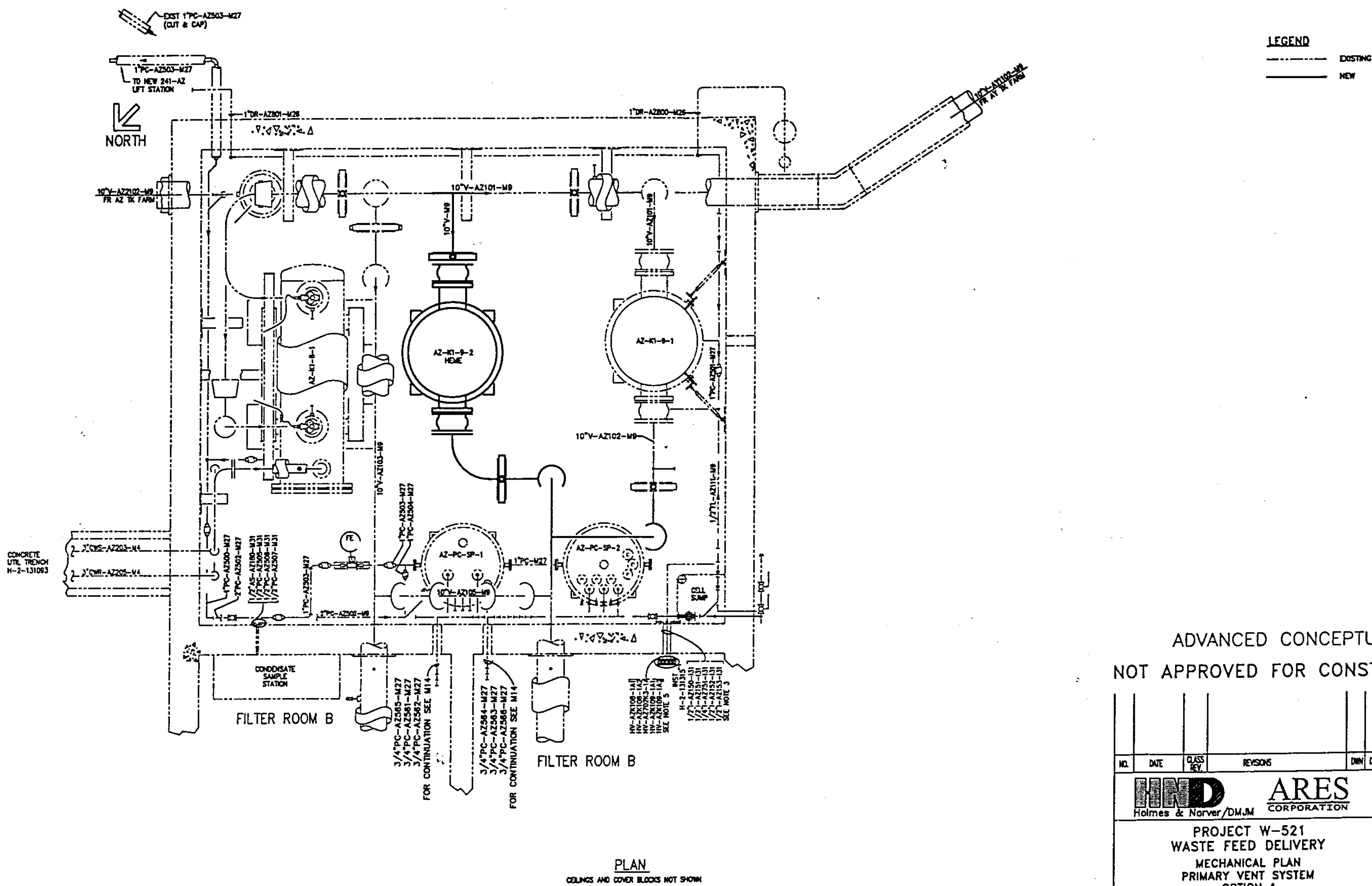
Table B.3. Failure Probability per Transfer for the Option 2.

Event No.	Description	Probability
1	Failure of Condenser / Heme Causes Loss of Exhaust Ventilation	1.03E-03
11	Condenser Fails	8.59E-04
111	Redundant Chiller Fails	1.91E-05
1111	Chiller 1 Fails	4.37E-03
11111	Chiller 1 Electrical Fails	5.04E-04
11112	Chiller 1 Mechanical Fails	3.36E-03
11113	Chiller 1 Controls Fail	3.36E-04
11114	Glycol Line 1 Fails	1.68E-04
1112	Chiller 2 Fails	4.37E-03
11121	Chiller 2 Electrical Fails	5.04E-04
11122	Chiller 2 Mechanical Fails	3.36E-03
11123	Chiller 2 Controls Fail	3.36E-04
11124	Glycol Line 2 Fails	1.68E-04
112	Condenser Tube Leaks	8.40E-04
12	Ducting Fails	1.68E-04
13	HEME Fails	4.06E-06
131	HEME System 1 Fails	2.02E-03
1311	HEME 1 Catastrophic Failure	1.68E-03
1312	Condensate Line 1 Plugs	1.68E-04
1313	HEME Duct 1 Fails	1.68E-04
132	HEME System 2 Fails	2.02E-03
1321	HEME 2 Catastrophic Failure	1.68E-03
1322	Condensate Line 2 Plugs	1.68E-04
1323	HEME Duct 2 Fails	1.68E-04
Probability is the probability of a failure per transfer		

Table B.4. Failure Probability per Transfer for the Option 3.

Event No.	Description	Probability
1	Failure of Condenser / Heme Causes Loss of Exhaust Ventilation	1.98E-04
11	Redundant Condensers Fail	2.89E-05
111	Condenser 1 Fails	5.38E-03
1111	Chiller 1 Fails	4.20E-03
11111	Chiller 1 Electrical Fails	5.04E-04
11112	Chiller 1 Mechanical Fails	3.36E-03
11113	Chiller 1 Controls Fail	3.36E-04
1112	Condenser 1 Tube Leak	8.40E-04
1113	Glycol Line 1 Fails	1.68E-04
1114	Condenser 1 Duct Fails	1.68E-04
112	Condenser 2 Fails	5.38E-03
1121	Chiller 2 Fails	4.20E-03
11211	Chiller 2 Electrical Fails	5.04E-04
11212	Chiller 2 Mechanical Fails	3.36E-03
11213	Chiller 2 Controls Fail	3.36E-04
1122	Condenser 2 Tube Leak	8.40E-04
1123	Glycol Line 2 Fails	1.68E-04
1124	Condenser 2 Duct Fails	1.68E-04
12	Ducting Fails	1.68E-04
13	HEME Fails	1.02E-06
131	HEME System 1 Fails	2.02E-03
1311	HEME 1 Catastrophic Failure	1.68E-03
1312	Condensate Line 1 Plugs	1.68E-04
1313	HEME Duct 1 Fails	1.68E-04
132	HEME System 2 Fails	5.04E-04
1321	HEME 2 Catastrophic Failure	1.68E-03
1322	Condensate Line 2 Plugs	1.68E-04
1323	HEME Duct 2 Fails	1.68E-04
Probability is the probability of a failure per transfer		

Appendix C
Drawings and Sketches



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL PLAN
PRIMARY VENT SYSTEM
OPTION 1

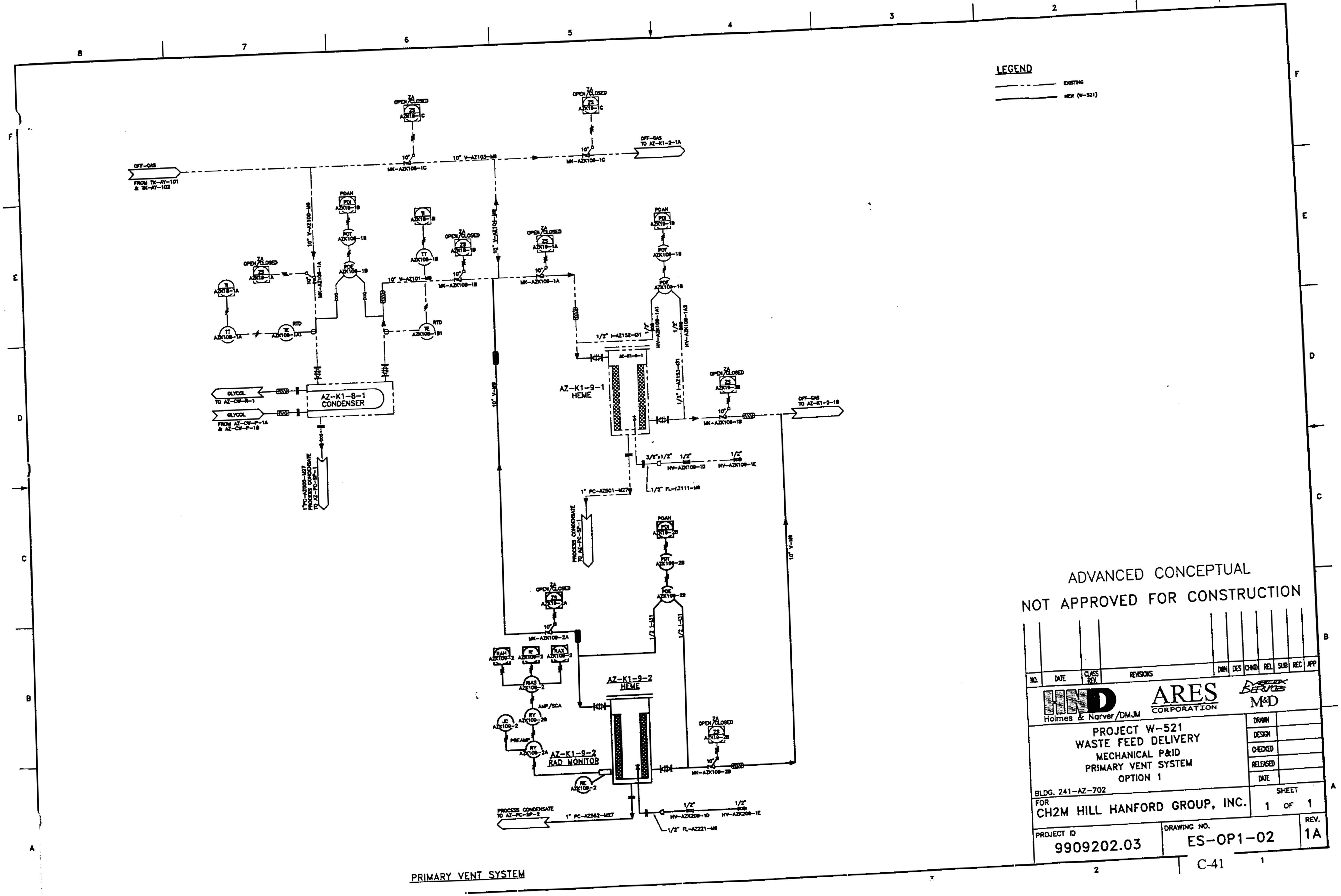
BLDG. 241-AZ-702

DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

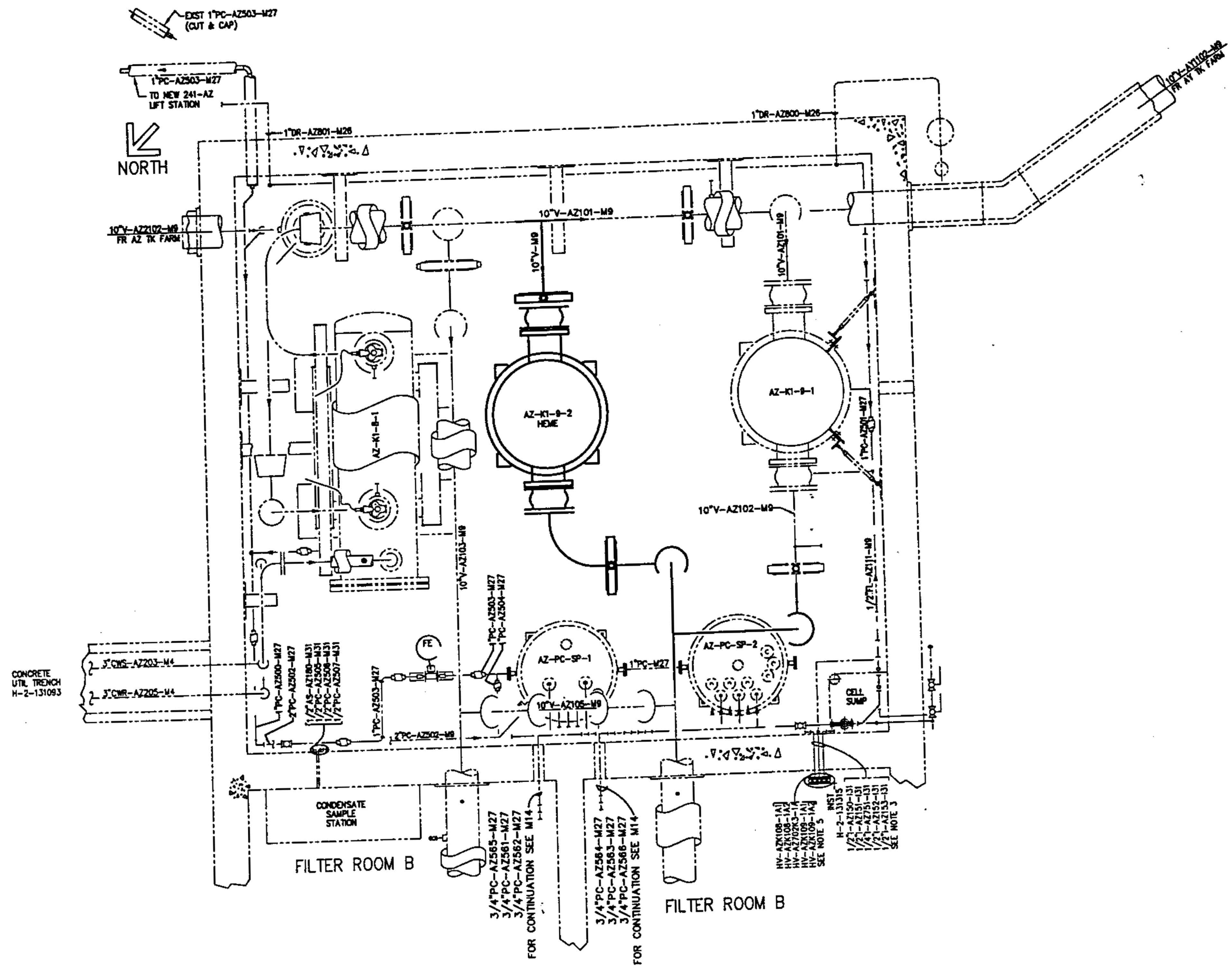
PROJECT ID	DRAWING NO.	REV.
9909202.03	ES-OP1-01	1A


LEGEND
EXISTING
NEW (W-521)
OFF-GAS FROM TK-AY-101 & TK-AY-102
OFF-GAS TO AZ-K1-2-1A
OFF-GAS TO AZ-K1-2-1B
AZ-K1-8-1 CONDENSER
GLYCOL TO AZ-CW-R-1
GLYCOL FROM AZ-CW-P-1A & AZ-CW-P-1B
AZ-K1-9-1 HEME
AZ-K1-9-2 HEME
AZ-K1-9-2 RAD MONITOR
PROCESS CONDENSATE TO AZ-PC-SP-1
PROCESS CONDENSATE TO AZ-PC-SP-2
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
ARES CORPORATION
Holmes & Narver/DMJM
M&D
PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL P&ID
PRIMARY VENT SYSTEM
OPTION 1
BLDG. 241-AZ-702
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1
PROJECT ID 9909202.03
DRAWING NO. ES-OP1-02
REV. 1A
PRIMARY VENT SYSTEM

LEGEND

EXISTING

NEW



PLAN

CEILINGS AND COVER BLOCKS NOT SHOWN

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL PLAN
PRIMARY VENT SYSTEM
OPTION 2

DRAWN
DESIGN
CHECKED
RELEASED
DATE

BLDG. 241-AZ-702

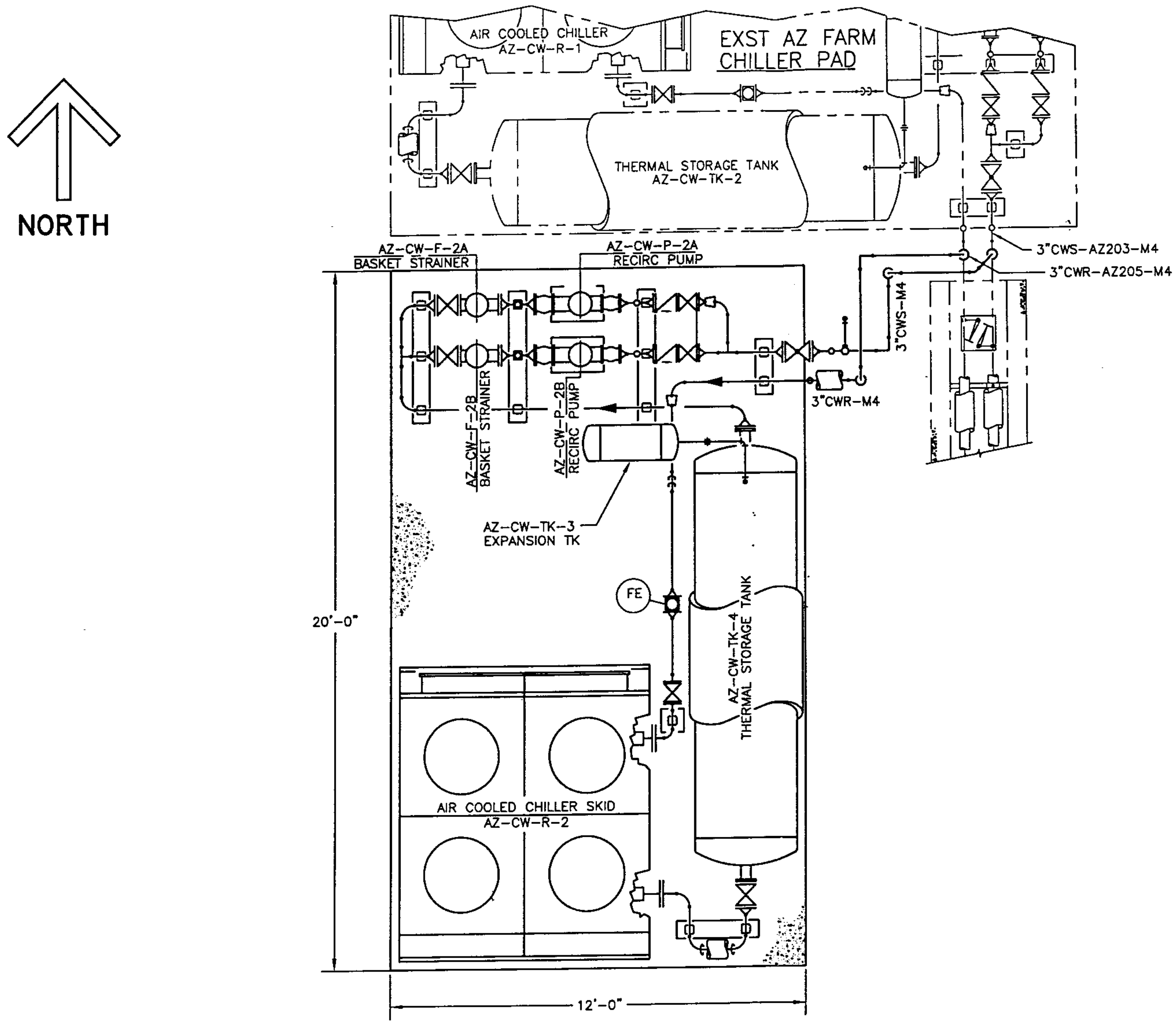
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ES-OP2-02

REV. 1A



CHILLER PAD PLAN
SCALE: NONE

LEGEND

- - - - EXISTING
———— NEW

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

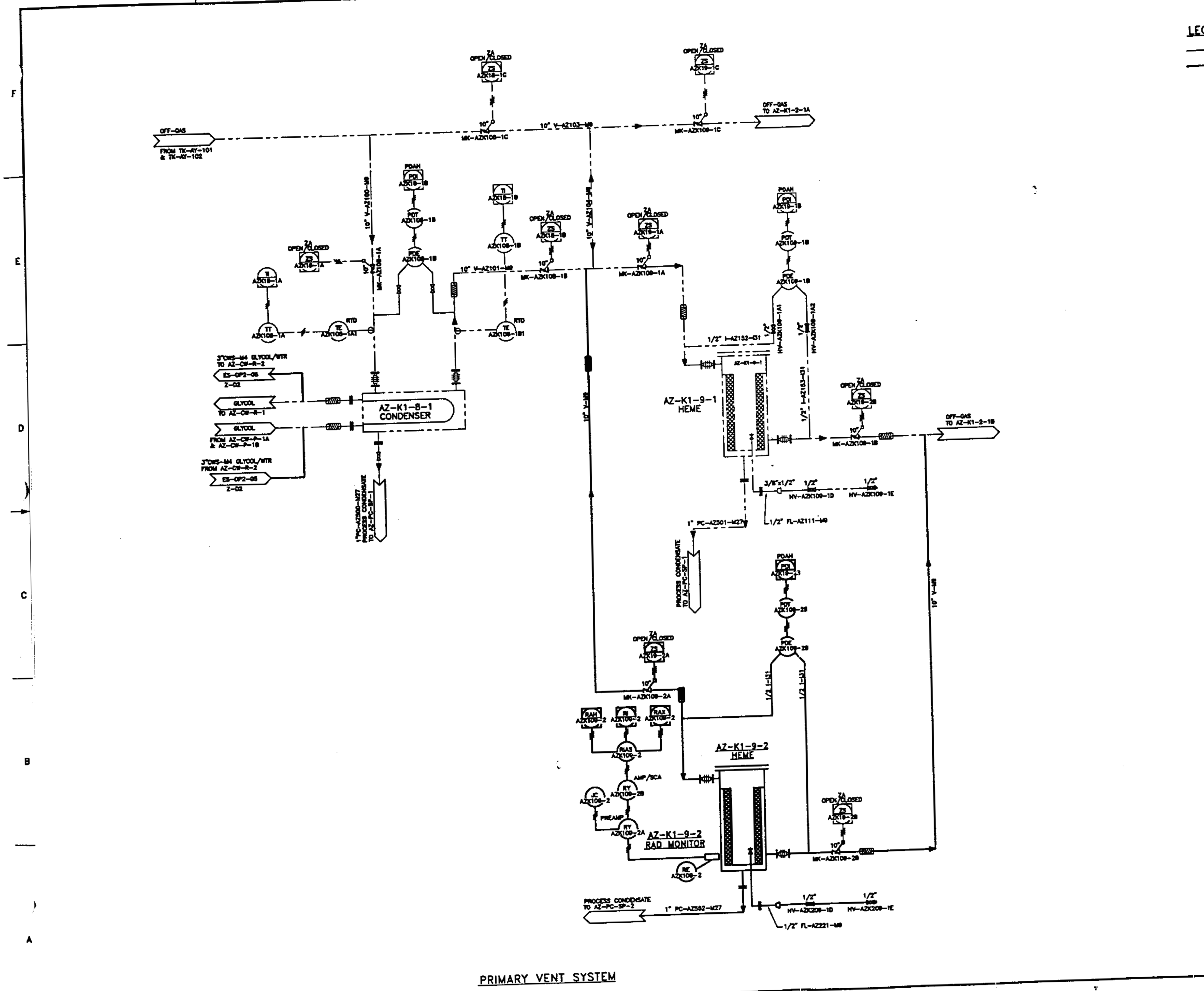
NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — Duratek Services M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
PRIMARY VENT CHILLER SYSTEM PLAN
OPTION 2
BLDG. 241-AZ-702

DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1
PROJECT ID 9909202.03
DRAWING NO. ES-OP2-03
REV. 1A



ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL P&ID
PRIMARY VENT SYSTEM
OPTION 2

BLDG. 241-AZ-702

FOR CH2M HILL HANFORD GROUP, INC.

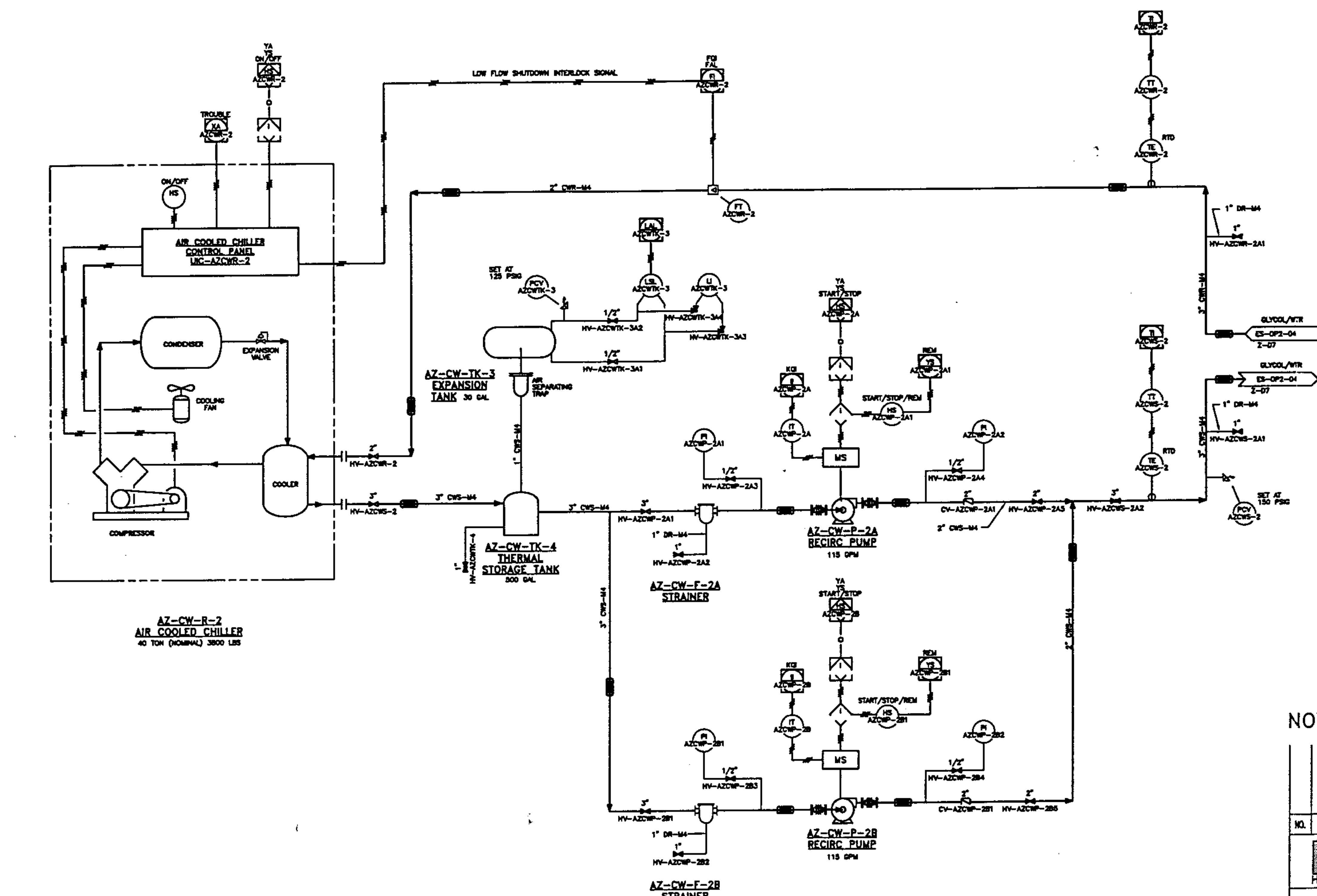
DRAWN
DESIGN
CHECKED
RELEASED
DATE

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ES-OP2-04

REV. 1A



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL P&ID
PRIMARY VENT SYSTEM
OPTION 2

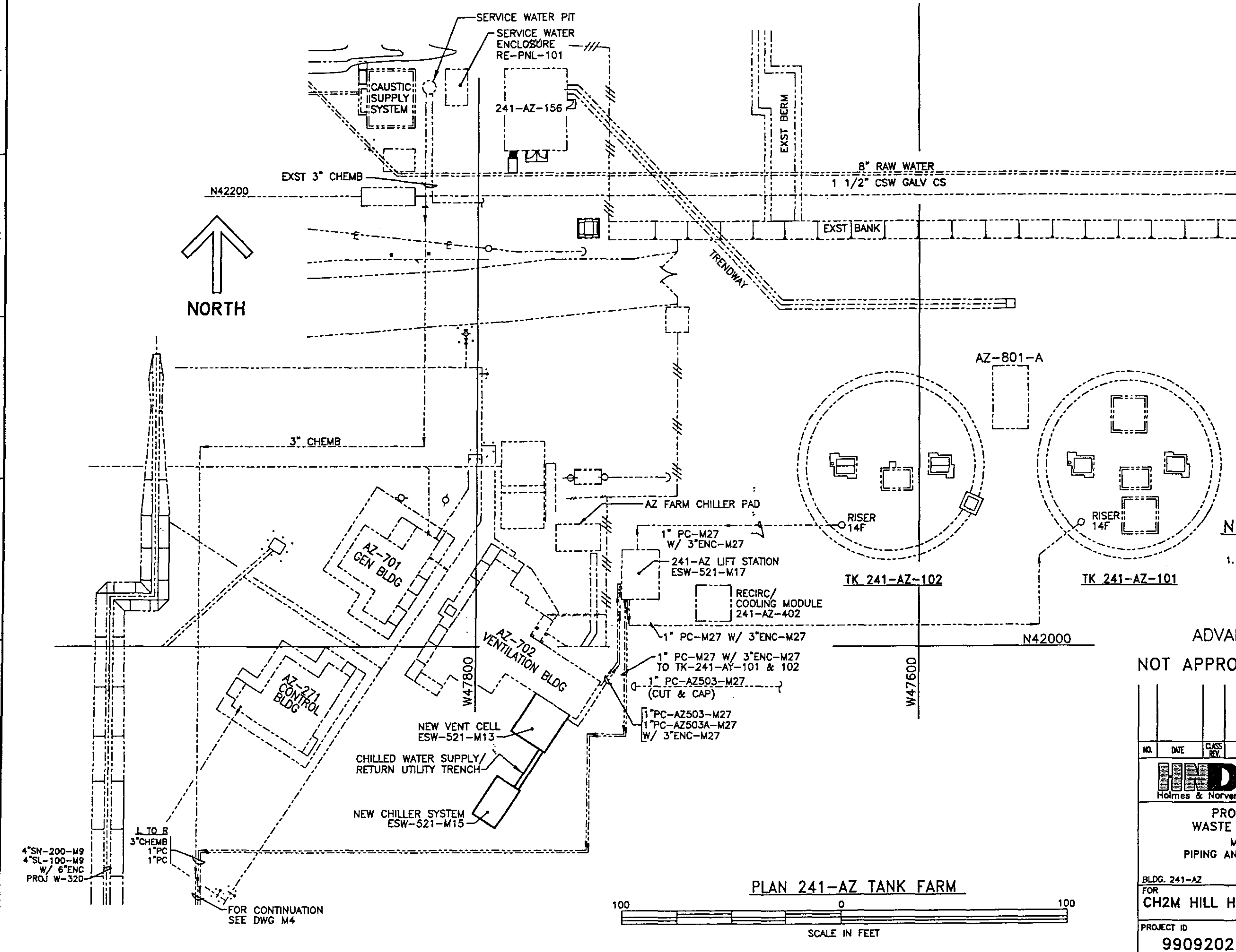
BLDG. 241-AZ-702

DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

FOR
CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ES-OP2-05	1A



NOTE:

1. SEE OUTLINE SPECIFICATION SECTIONS: 15493 15499

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM | ARES CORPORATION | M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
PIPING AND EQUIPMENT PLAN
OPTION 3

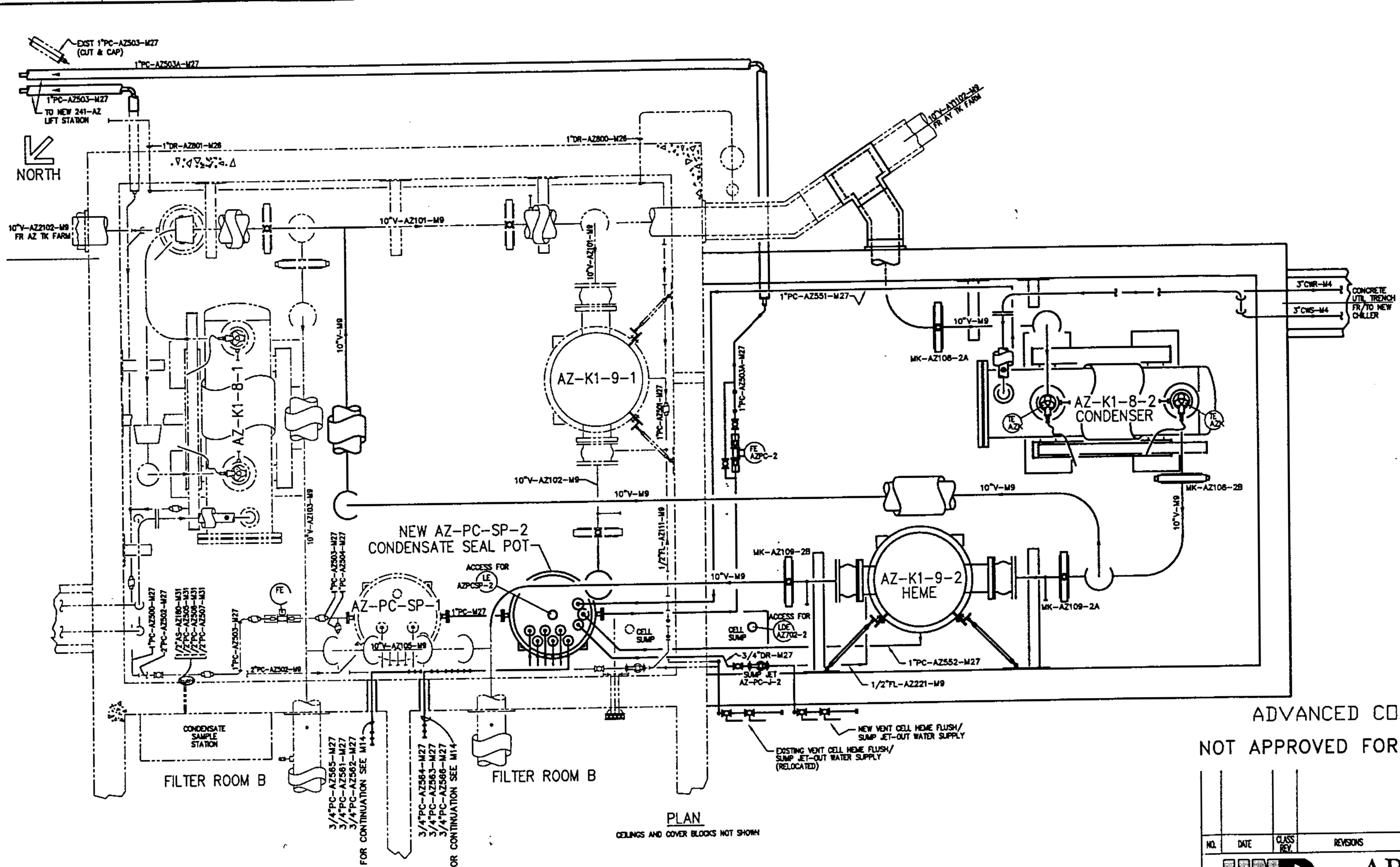
DRAWN / DESIGN / CHECKED / RELEASED / DATE

BLDG. 241-AZ

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ES-OP3-01 | REV. 1A



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL PLAN
PRIMARY VENT CONDENSATE SYSTEM
OPTION 3

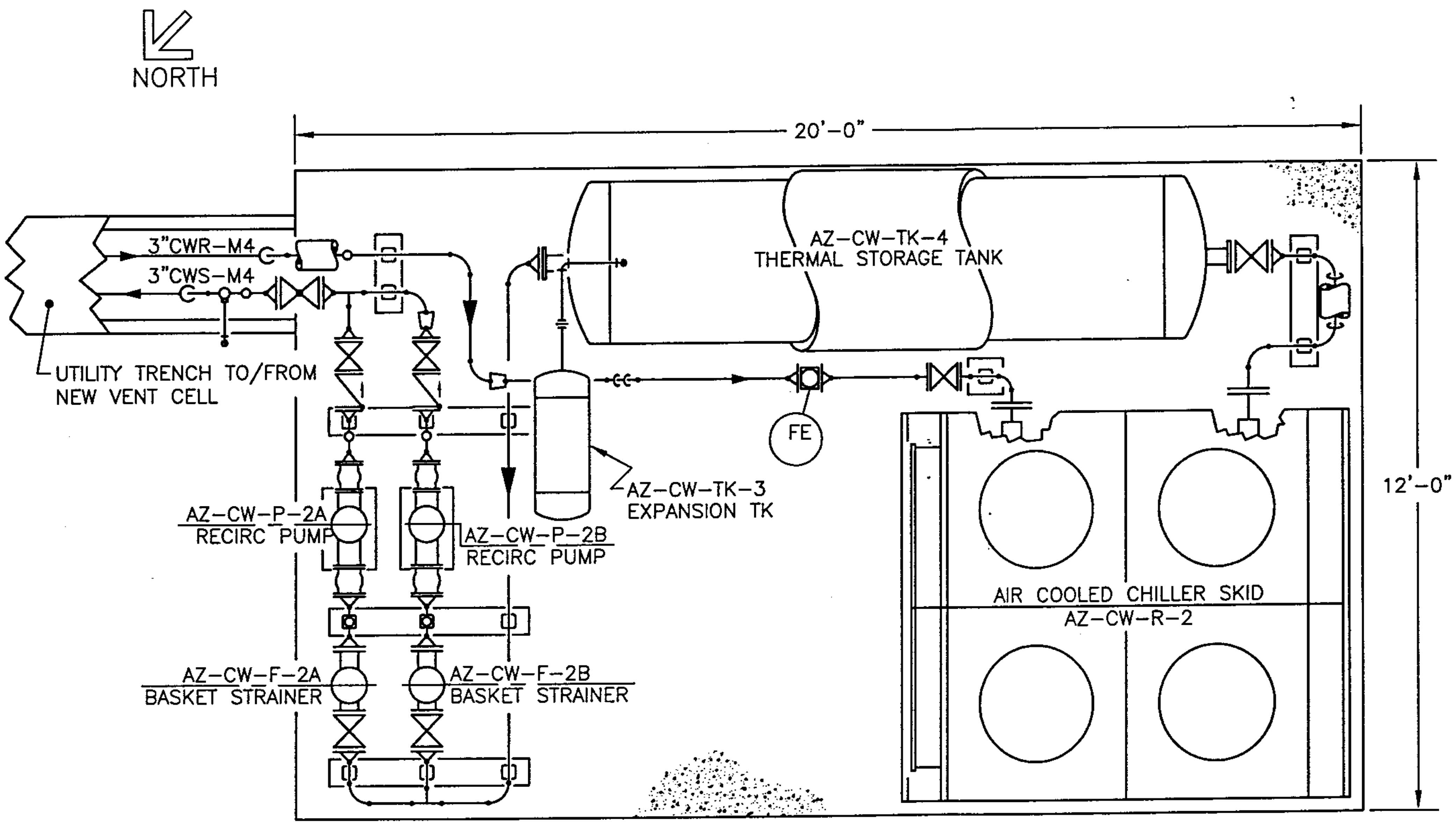
DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

BLDG. 241-AZ-702

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ES-OP3-02	1A



CHILLER PAD PLAN

SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

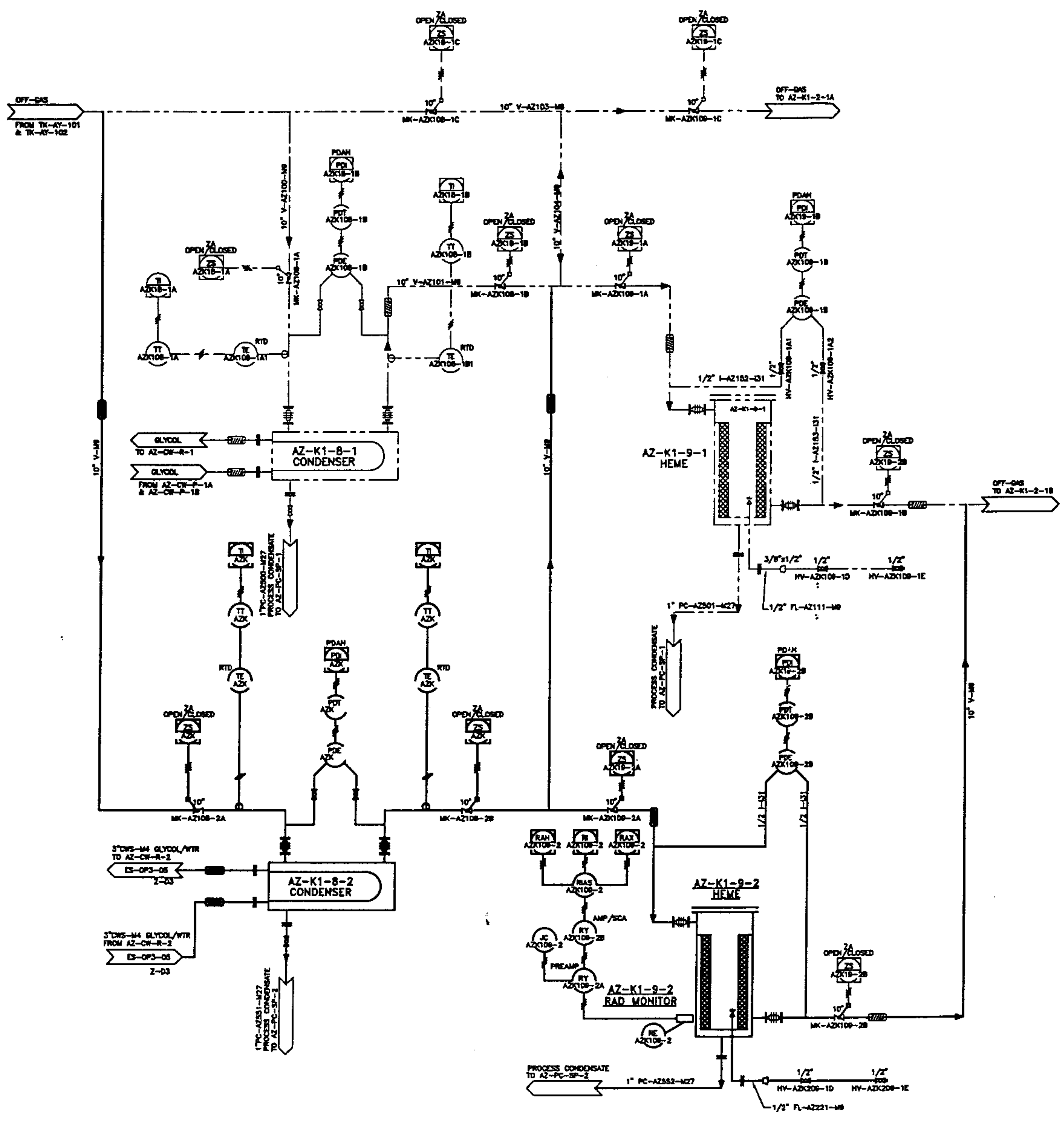
Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521 WASTE FEED DELIVERY MECHANICAL PRIMARY VENT CHILLER SYSTEM PLAN OPTION 3	DRAWN	
	DESIGN	
	CHECKED	
	RELEASED	
BLDG. 241-AZ-702	DATE	
FOR CH2M HILL HANFORD GROUP, INC.	SHEET 1 OF 1	
PROJECT ID 9909202.03	DRAWING NO. ES-OP3-03	REV. 1A

LEGEND

EXISTING

NEW (W-521)



PRIMARY VENT SYSTEM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL P&ID
PRIMARY VENT SYSTEM
OPTION 3

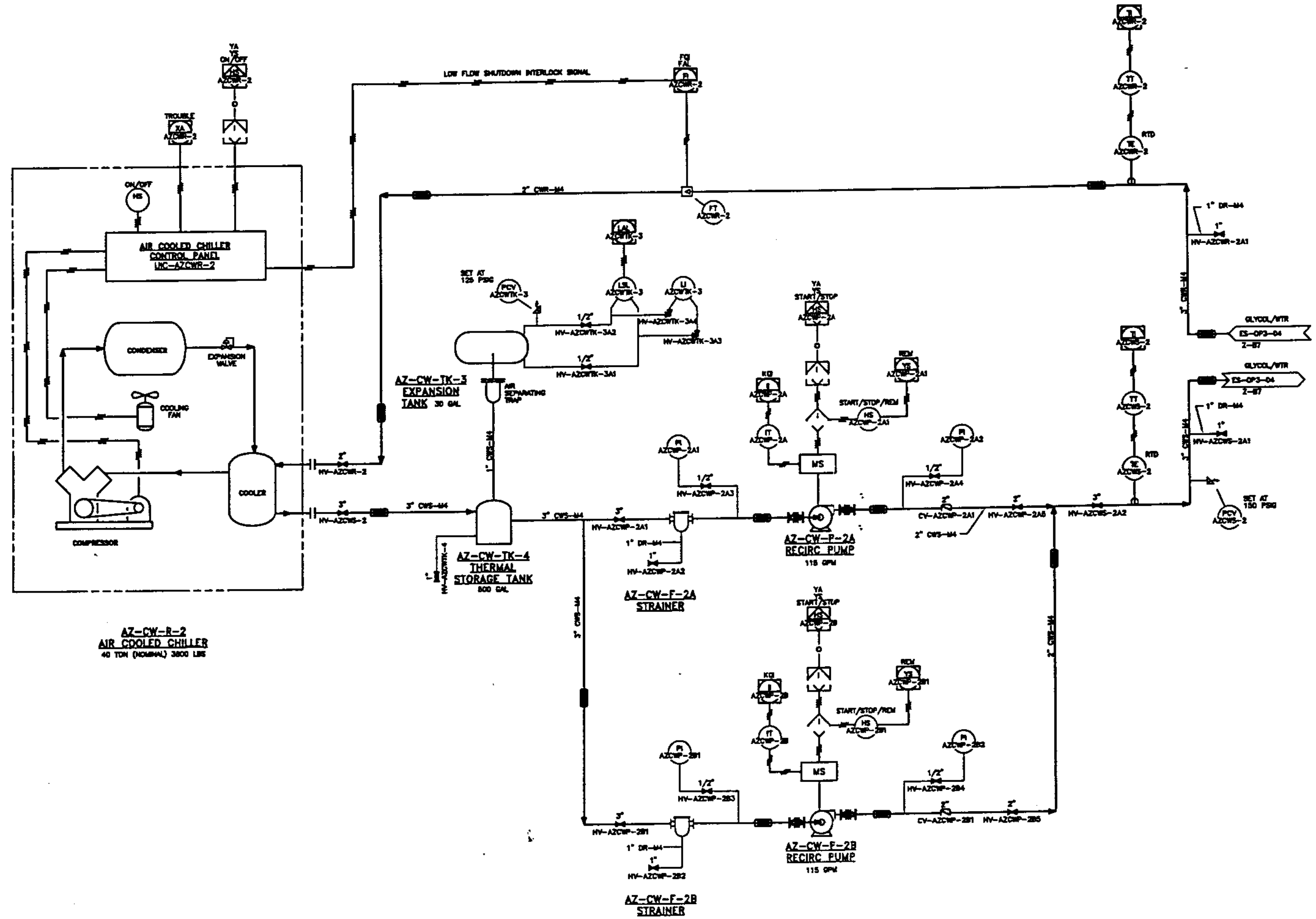
BLDG. 241-AZ-702

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN / DESIGN / CHECKED / RELEASED / DATE

SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ES-OP3-04 | REV. 1A



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL P&ID
PRIMARY VENT SYSTEM
OPTION 3

BLDG. 241-AZ-702

FOR
CH2M HILL HANFORD GROUP, INC.

DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ES-OP3-05	1A

Appendix D
Cost Estimate Analysis

W-521 AGA FOR AY/AZ PRIMAR . VENTILATION SYSTEM AZ-702
OPTIONS COMPARISON

WBS	DESCRIPTION	EXISTING CONFIG	OPTION 1	OPTION 2	OPTION 3
1.1	PROJECT MANAGEMENT	0	46,000	68,000	201,000
1.2.1	DEFINITIVE DESIGN	0	248,000	368,000	1,092,000
1.2.2	TITLE III	0	91,000	135,000	400,000
1.2.3	STARTUP/OPERATION TEST SUPPORT	0	19,000	28,000	83,000
1.3	EXPENSE FUNDED PROJ. ACTIVITIES	0	111,000	165,000	489,000
1.4	CONSTRUCTION	0	1,239,000	1,841,000	5,464,000
1.6	STARTUP/TURNOVER	0	50,000	74,000	219,000
TOTAL		-	1,804,000	2,679,000	7,948,000

W-521 AGA FOR AY/AZ PRIMARY VENTILATION SYSTEM AZ-702 OPTION 1

WE ID#	DESCRIPTION	WBS #	TOTAL COST	SWP	CON-TRACT TYPE	QTY	UNIT	HRS/ UNIT	HRS	LABOR COST/ HR	EQP USAGE COST/ HR AVE = $ 5.00	MATL COST/ UNIT	S/C COST/ UNIT	EQUIP COST/ UNIT	ADDL LABOR HRS FOR SWP WORK	LABOR	EQP USAGE	MATL	S/C	EQUIP
0102803	PIT SPECIAL PROT. COATING(AMERCOAT)FOR NEW VENT ANNEX BLDG	1520406		W	CPAF	-	EA	240.0	-	31.00	-	1,000.00		-	-	-	-	-	-	-
0230006	HAND EXCAV & BACKFILL / NEW VENT. BLDG ANNEX & EQUIP PADS	1520406		W	CPAF	-	CY	8.0	-	32.44	3.72	-		-	-	-	-	-	-	-
0230009	PACKAGE AND HAUL OFF CONTAMINATED SOIL	1520406		W	CPAF	-	CY	4.0	-	34.40	45.84	600.00			-	-	-	-	-	-
0230154	SHORING	1520406		W	CPAF	-	SF	0.1	-	40.00	8.90	7.38			-	-	-	-	-	-
0311003	REINFORCING BAR FOR VENT BLDG. & EQUIP. PADS	1520406		W	CPAF	-	LOT		-		-		10,000		-	-	-	-	-	-
0311006	PROCURE OFFSITE COVER BLOCK SETS - INCLUDES ID PAINTING/VENT BLDG	1520406		X	CPAF	1	EA		-		-	63,000.00			-	-	-	63,000	-	-
0311008	CONCRETE VENTILATION ANNEX BLDG.	1520406		W	CPAF	-	CY		-		-		900		-	-	-	-	-	-
0311025	CONCRETE PAD 10X25X1	1520406		W	CPAF	-	EA	160.0	-	33.71	8.20	1,425.00			-	-	-	-	-	-
0550002	GRATING AND LADDER	1520406		S	CPAF	-	LS	192.0	-	35.75	28.65	20,000.00			-	-	-	-	-	-
1502100	INSTALL COVER BLK. SETS, VENT BLDG	1520406		S	CPAF	1	EA	450.0	450	38.35	7.73				3,452	17,258	3,479	-	-	-
1560022	10" BUTTERFLY VALVE SST INSTALL ONLY	1520406		W	CPAF	2	EA	32.0	64	46.00	4.41				1,178	2,944	282	-	-	-
1560024	KNOCK OUT VENTILATION CELL WALL (6" CONC BLOCK WALL)	1520406		M	CPAF	-	SF	10.0	-	35.85	6.40	72.00			-	-	-	-	-	-
1560026	DRAIN SUMP/ PUMP	1520406		W	CPAF	-	EA	80.0	-	46.00	4.41	45,000.00			-	-	-	-	-	-
1560028	CONDENSER, CONDENSER PIPING AND SUPPORTS	1520406		W	CPAF	-	EA	120.0	-	46.00	4.41	95,000.00			-	-	-	-	-	-
1560029	CHILLER W / SUPPORTS	1520406		W	CPAF	-	EA	160.0	-	46.00	4.41	72,000.00			-	-	-	-	-	-
1560030	HEME (HIGH EFFICIENCY MIST ELIMINATOR) W / SUPPORTS	1520406		W	CPAF	1	EA	40.0	40	46.00	4.40	81,000.00			736	1,840	176	81,000	-	-
1560034	10" SST PIPE W / FITTINGS INSTALL ONLY	1520406		M	CPAF	60	FT	20.0	1,200	46.00	4.42				55,200	55,200	5,304	-	-	-
1560038	SEAL POT W / SUPPORTS INSTALL ONLY	1520406		W	CPAF	-	EA	40.0	-	46.00	4.20	-			-	-	-	-	-	-
1560040	SEAL POT HOT TAP (INTO EXST SEAL POT)	1520406		M	CPAF	-	EA	32.0	-	46.00	4.40	2,000.00			-	-	-	-	-	-
1560044	5 HP PUMP	1520406		W	CPAF	-	EA	24.0	-	46.00	4.40	7,200.00			-	-	-	-	-	-
1560046	EXPANSION TANK	1520406		W	CPAF	-	EA	80.0	-	46.00	4.40	5,000.00			-	-	-	-	-	-
1560048	THERMAL EXPANSION TANK	1520406		W	CPAF	-	EA	120.0	-	42.67	11.72	40,000.00			-	-	-	-	-	-
1560050	REMOTE VALVE OPERATORS	1520406		W	CPAF	2	EA	40.0	80	46.00	4.41	20,000.00			1,472	3,680	353	40,000	-	-
1630024	MINI POWER PANEL W / SUPPORTS	1520406		W	CPAF	-	EA	16.0	-	44.00	-	5,300.00			-	-	-	-	-	-
1630025	MOTOR CONTROL CENTER	1520406		W	CPAF	-	EA	40.0	-	44.00	-				-	-	-	-	-	-
1650010	ELEC. TERMINATIONS (GROUPED BY 40 HOURS INCREMENTS)	1520406		W	CPAF	-	LOT	40.0	-	44.00	-	60.00			-	-	-	-	-	-
1650024	1 1/2" CONDUIT	1520406		W	CPAF	-	LF	0.2	-	44.00	-	7.20			-	-	-	-	-	-
1650042	#2 POWER CABLE	1520406		W	CPAF	-	LF	0.0	-	44.00	-	0.60			-	-	-	-	-	-
1680020	INSTRUMENT INSTALLATION	1520406		W	CPAF	7	EA	4.0	28	44.00	-	360.00			493	1,232	-	2,520	-	-
1560006	10" BUTTERFLY VALVE SST	151040205		X	FP	2	EA		-		-	18,000.00			-	-	-	36,000	-	-
1560006	10" SST PIPE W / FITTINGS	151040205		X	FP	60	LF		-		-	450.00			-	-	-	27,000	-	-
1560006	SEAL POT	151040205		X	FP	-	EA		-		-	14,400.00			-	-	-	-	-	-
N/A	RAD MONITOR	1520406		W	CPAF	1	EA	60.0	60	44.00		1,200.00			1,056	2,640	300	1,200	-	-
N/A	METAL ACCESS DOOR (TO RAD MONITOR)	1520406		W	CPAF	1	EA	40.0	40	40.00		5,000.00			640	1,600	200	5,000	-	-
N/A	CHILLED WATER PIPING W/ FITTINGS	1520406		W	CPAF	-	FT	0.85	-	42.40	8.83	14.00			-	-	-	-	-	-
N/A	CHILLED WATER SKID INSTRUMENTATION ALLOWANCE	1520406		W	CPAF	-	LOT	120.0	-	44.00		5,000.00			-	-	-	-	-	-
N/A	ROOF ACCESS SIZE INCREASE	1520406		M	CPAF	1	LOT	200.0	200	41.33		3,000.00			8,266	8,266	1,000	3,000	-	-
1501004	COREDRILL FOR METAL DOOR	1520406		M	CPAF	1	EA	150.0	150	41.33	1.42	2,000.00			6,200	6,200	213	2,000	-	-
	ITEMS IN CDR EST BUT ARE NOT NECESSARY																			
0830004	DOOR W / AIRLOCK	1520406		W	CPAF	-	EA	200.0	-	37.00	19.10	45,000.00			-	-	-	-	-	-
0830005	DOOR W / AIRLOCK (INSTALLED IN EXISTING VENT BLDG.)	1520406		M	CPAF	-	EA	200.0	-	37.00	19.10	45,000.00			-	-	-	-	-	-
0850002	VIEWPORTS	1520406		W	CPAF	-	EA	16.0	-	36.00	-	7,200.00			-	-	-	-	-	-
	CPAF		*309,886*												*78,691*	*100,859*	*11,307*	*197,720*	-	-
	FP		*63,000*												-	-	-	*63,000*	-	-
BASE COST SUBTOTAL			**372,886**						1,862						62,530	**100,859**	**11,307**	**260,720**	-	-

6A	SWP LABOR DOLLARS	VARIES	62,530	
6B	CONSUMABLES	4.0%	4,034	*LABOR * 4% CPAF ONLY*
6C	GF / FOREMAN	10.0%	17,955	*(LABOR + SWP) * 10% CPAF ONLY*
6D	QUALITY INSPECTION	3.0%	5,387	*(LABOR + SWP) * 3% CPAF ONLY*
6E	CLEANUP	8.0%	14,364	*(LABOR + SWP) * 8% CPAF ONLY*
6F	PERSONNEL / MATL MOVEMENT	4.0%	7,182	*(LABOR + SWP) * 4% CPAF ONLY*
6G	WASH ST SALES TAX	8.0%	21,180	*(MATL + EQUIP + CONSUMBLS) * 8%*
ODC'S			**132,632**	
7A	FP SUBCONTRACTOR MARKUP	10.0%	-	*S/C * 10% FP ONLY*
7B	FP CONTRACTOR MARKUP	42.0%	26,460	*(LABOR + EQP USAGE + MATL + EQUIP) * 42% FP ONLY*
7C	FP CM	22.0%	13,860	*(LABOR + EQP USAGE + MATL + S/C + EQUIP) * 22% FP ONLY*
7D	CF CM	36.0%	151,681	*(BASE COST SUBTOTAL + SWP + CONSUMBLS + GF/F + QUAL INSP + CLEANUP + MATL MVMT) * 36% CPAF ONLY*
CONTRACTOR MKUP & CM SUBTOTAL			**192,001**	
ESTIMATE SUBTOTAL			**697,519**	
7E	GOVT EQUIP SURCHARGE	5.0%	8,978	*(LABOR + SWP) * 5% CPAF ONLY*
7F	SHARED SERVICES & PHMC G&A	18.0%	125,553	*ESTIMATE SUBTOTAL * 18%*
SITE ALLOCATIONS SUBTOTAL			**832,050**	
	ESCALATION	18.18%	151,267	*SITE ALLOCATIONS SUBTOTAL * ESCAL RATE*
CONSTR. ESCALATION SUBTOTAL			**983,317**	
	CONTINGENCY	26.0%	255,662	*ESCALATION SUBTOTAL * CONTINGENCY RATE*
CONSTRUCTION GRAND TOTAL			***1,238,979***	

SWP FACTOR LEGEND
X= No work performed in SWP
S=Partial work performed (1.2 of labor hrs)
W= Work performed in whites (1.4 of labor hrs)
M=Work performed in whites and with mask (2.0 of labor hrs)

ESTIMATE SUMMARY
Scope of work consists of
1.) Pumping tank to remove all remaining liquid, removing all equipment (pump, jumpers, etc.).
2.) Abandon tank in place.

Escalation for WBS 1.1 & 1.3 are assumed to be same as WBS 1.2.2

PRICING JUSTIFICATION
Basis for pricing consist of reference to projects of similar nature, WS Means Estimating, and previous W-521 cdr cost estimate.

WBS #	OTHER TASKS	% OF CONSTR	Basis	Subtotal	SITE ALLOCATIONS %	SITE ALLOCATIONS Site Allocations Subtotal	ESCALATION %	ESCALATION Escal. Subtotal	CONTINGENCY %	CONTINGENCY Conting Subtotal	SUBTOTAL
1.1	PROJECT MANAGEMENT	5.0%	Mainly LOE effort	34,876			18.95%	6,609	10.00%	4,148	45,633
1.2	ENGINEERING										
1.2.1	DEFINITIVE DESIGN	25.0%	Full %	174,380	18%	31,388	12.98%	26,709	20.00%	46,495	247,584
1.2.2	TITLE III	8.3%	Full %	57,545	18%	10,358	18.95%	12,868	25.00%	20,193	90,606
1.2.3	STARTUP/OPERATION TEST SUPPORT	1.7%	Full %	11,858	18%	2,134	24.22%	3,389	20.00%	3,476	18,723
1.3	EXPENSE FUNDED PROJ. ACTIVITIES	12.0%	Dgn/Const/Oper sppt full %	83,702			18.95%	15,862	11.22%	11,171	110,735
1.6	STARTUP/TURNOVER	5.0%	Oper crews minimal reduct	34,876			23.64%	8,245	15.00%	6,468	49,589
										OTHER TASKS TOTAL	562,870
										GRAND TOTAL	**1,801,849**

W-521 AGA FOR AY/AZ PRIMARY VENTILATION SYSTEM AZ-702 OPTION 2

WE ID#	DESCRIPTION	WBS #	TOTAL COST	SWP	CON-TRACT TYPE	QTY	UNIT	HRS/ UNIT	HRS	LABOR COST/ HR	EQP USAGE COST/ HR AVE = $ 5.00	MATL COST/ UNIT	S/C COST/ UNIT	EQUIP COST/ UNIT	ADDL LABOR HRS FOR SWP WORK	LABOR	EQP USAGE	MATL	S/C	EQUIP
0102803	PIT SPECIAL PROT. COATING(AMERCOAT)FOR NEW VENT ANNEX BLDG	1520406		W	CPAF	-	EA	240.0	-	31.00	-	1,000.00		-	-	-	-	-	-	-
0230006	HAND EXCAV & BACKFILL / NEW VENT. BLDG ANNEX & EQUIP PADS	1520406		W	CPAF	10	CY	8.0	80	32.44	3.72	-		-	1,038	2,595	298	-	-	-
0230009	PACKAGE AND HAUL OFF CONTAMINATED SOIL	1520406		W	CPAF	10	CY	4.0	40	34.40	45.84	600.00			550	1,376	1,834	6,000	-	-
0230154	SHORING	1520406		W	CPAF	-	SF	0.133	-	40.00	8.90	7.38			-	-	-	-	-	-
0311003	REINFORCING BAR FOR VENT BLDG. & EQUIP. PADS	1520406		W	CPAF	1	LOT		-		-		10,000		-	-	-	-	10,000	-
0311006	PROCURE OFFSITE COVER BLOCK SETS - INCLUDES ID PAINTING/VENT BLDG	1520406		X	CPAF	1	SET		-		-	63,000.00			-	-	-	63,000	-	-
0311008	CONCRETE VENTILATION ANNEX BLDG.	1520406		W	CPAF	-	CY		-		-		900		-	-	-	-	-	-
0311025	CONCRETE PAD 10X25X1	1520406		W	CPAF	1	EA	160.0	160	33.71	8.20	1,425.00			2,157	5,394	1,312	1,425	-	-
0550002	GRATING AND LADDER	1520406		S	CPAF	-	LS	192.0	-	35.75	28.65	20,000.00			-	-	-	-	-	-
1502100	INSTALL COVER BLK. SETS, VENT BLDG	1520406		S	CPAF	1	EA	450.0	450	38.35	7.73				3,452	17,258	3,479	-	-	-
1560022	10" BUTTERFLY VALVE SST INSTALL ONLY	1520406		W	CPAF	2	EA	32.0	64	46.00	4.41				1,178	2,944	282	-	-	-
1560024	KNOCK OUT VENTILATION CELL WALL (6" CONC BLOCK WALL)	1520406		M	CPAF	-	SF	10.0	-	35.85	6.40	72.00			-	-	-	-	-	-
1560026	DRAIN SUMP/ PUMP	1520406		W	CPAF	-	EA	80.0	-	46.00	4.41	45,000.00			-	-	-	-	-	-
1560028	CONDENSER, CONDENSER PIPING AND SUPPORTS	1520406		W	CPAF	-	EA	120.0	-	46.00	4.41	95,000.00			-	-	-	-	-	-
1560029	CHILLER W / SUPPORTS	1520406		W	CPAF	1	EA	160.0	160	46.00	4.41	72,000.00			2,944	7,360	706	72,000	-	-
1560030	HEME (HIGH EFFICIENCY MIST ELIMINATOR) W / SUPPORTS	1520406		W	CPAF	1	EA	40.0	40	46.00	4.40	81,000.00			736	1,840	176	81,000	-	-
1560034	10" SST PIPE W / FITTINGS INSTALL ONLY	1520406		M	CPAF	60	FT	20.0	1,200	46.00	4.42				55,200	55,200	5,304	-	-	-
1560038	SEAL POT W / SUPPORTS INSTALL ONLY	1520406		W	CPAF	-	EA	40.0	-	46.00	4.20	-			-	-	-	-	-	-
1560040	SEAL POT HOT TAP (INTO EXST SEAL POT)	1520406		M	CPAF	-	EA	32.0	-	46.00	4.40	2,000.00			-	-	-	-	-	-
1560044	5 HP PUMP	1520406		W	CPAF	2	EA	24.0	48	46.00	4.40	7,200.00			883	2,208	211	14,400	-	-
1560046	EXPANSION TANK	1520406		W	CPAF	1	EA	80.0	80	46.00	4.40	5,000.00			1,472	3,680	352	5,000	-	-
1560048	THERMAL EXPANSION TANK	1520406		W	CPAF	1	EA	120.0	120	42.67	11.72	40,000.00			2,048	5,120	1,406	40,000	-	-
1560050	REMOTE VALVE OPERATORS	1520406		W	CPAF	2	EA	40.0	80	46.00	4.41	20,000.00			1,472	3,680	353	40,000	-	-
1630024	MINI POWER PANEL W / SUPPORTS	1520406		W	CPAF	1	EA	16.0	16	44.00	-	5,300.00			282	704	-	5,300	-	-
1630025	MOTOR CONTROL CENTER	1520406		W	CPAF	1	EA	40.0	40	44.00	-				704	1,760	-	-	-	-
1650010	ELEC. TERMINATIONS (GROUPED BY 40 HOURS INCREMENTS)	1520406		W	CPAF	2	LOT	40.0	80	44.00	-	60.00			1,408	3,520	-	120	-	-
1650024	1 1/2" CONDUIT	1520406		W	CPAF	200	LF	0.2	36	44.00	-	7.20			634	1,584	-	1,440	-	-
1650042	#2 POWER CABLE	1520406		W	CPAF	200	LF	0.0	3	44.00	-	0.60			60	150	-	120	-	-
1680020	INSTRUMENT INSTALLATION	1520406		W	CPAF	7	EA	4.0	28	44.00	-	360.00			493	1,232	-	2,520	-	-
1560006	10" BUTTERFLY VALVE SST	151040205		X	FP	2	EA		-		-	18,000.00			-	-	-	36,000	-	-
1560006	10" SST PIPE W / FITTINGS	151040205		X	FP	60	LF		-		-	450.00			-	-	-	27,000	-	-
1560006	SEAL POT	151040205		X	FP	-	EA		-		-	14,400.00			-	-	-	-	-	-
N/A	RAD MONITOR	1520406		W	CPAF	1	EA	60.0	60	44.00		1,200.00			1,056	2,640	300	1,200	-	-
N/A	METAL ACCESS DOOR (TO RAD MONITOR)	1520406		W	CPAF	1	EA	40.0	40	40.00		5,000.00			640	1,600	200	5,000	-	-
N/A	CHILLED WATER PIPING W/ FITTINGS	1520406		W	CPAF	40	FT	0.85	34	42.40	8.83	14.00			577	1,442	300	560	-	-
N/A	CHILLED WATER SKID INSTRUMENTATION ALLOWANCE	1520406		W	CPAF	1	LOT	120.0	120	44.00		5,000.00			2,112	5,280	600	5,000	-	-
N/A	ROOF ACCESS SIZE INCREASE	1520406		M	CPAF	1	LOT	200.0	200	41.33		3,000.00			8,266	8,266	1,000	3,000	-	-
1501004	COREDRILL FOR METAL DOOR	1520406		M	CPAF	1	EA	150.0	150	41.33	1.42	2,000.00			6,200	6,200	213	2,000	-	-
ITEMS IN CDR EST BUT ARE NOT NECESSARY																				
0830004	DOOR W / AIRLOCK	1520406		W	CPAF	-	EA	200.0	-	37.00	19.10	45,000.00			-	-	-	-	-	-
0830005	DOOR W / AIRLOCK (INSTALLED IN EXISTING VENT BLDG.)	1520406		M	CPAF	-	EA	200.0	-	37.00	19.10	45,000.00			-	-	-	-	-	-
0850002	VIEWPORTS	1520406		W	CPAF	-	EA	16.0	-	36.00	-	7,200.00			-	-	-	-	-	-
	CPAF		520,442												95,560	143,031	18,325	349,085	10,000	-
	FP		63,000												-	-	-	63,000	-	-
BASE COST SUBTOTAL			583,442						2,725						76,710	143,031	18,325	412,085	10,000	-

6A	SWP LABOR DOLLARS	VARIES	76,710	
6B	CONSUMABLES	4.0%	5,721	LABOR * 4% CPAF ONLY
6C	GF / FOREMAN	10.0%	23,859	(LABOR + SWP) * 10% CPAF ONLY
6D	QUALITY INSPECTION	3.0%	7,158	(LABOR + SWP) * 3% CPAF ONLY
6E	CLEANUP	8.0%	19,087	(LABOR + SWP) * 8% CPAF ONLY
6F	PERSONNEL / MATL MOVEMENT	4.0%	9,544	(LABOR + SWP) * 4% CPAF ONLY
6G	WASH ST SALES TAX	8.0%	33,425	(MATL + EQUIP + CONSUMBLS) * 8%
ODC'S			175,504	
7A	FP SUBCONTRACTOR MARKUP	10.0%	-	S/C * 10% FP ONLY
7B	FP CONTRACTOR MARKUP	42.0%	26,460	(LABOR + EQP USAGE + MATL + EQUIP) * 42% FP ONLY
7C	FP CM	22.0%	13,860	(LABOR + EQP USAGE + MATL + S/C + EQUIP) * 22% FP ONLY
7D	CF CM	36.0%	238,506	(BASE COST SUBTOTAL + SWP + CONSUMBLS + GF/F + QUAL INSP + CLEANUP + MATL MVMT) * 36% CPAF ONLY
CONTRACTOR MKUP & CM SUBTOTAL			278,828	
ESTIMATE SUBTOTAL			1,037,773	
7E	GOVT EQUIP SURCHARGE	5.0%	11,930	(LABOR + SWP) * 5% CPAF ONLY
7F	SHARED SERVICES & PHMC G&A	18.0%	186,799	ESTIMATE SUBTOTAL * 18%
SITE ALLOCATIONS SUBTOTAL			1,236,502	
	ESCALATION	18.18%	224,796	SITE ALLOCATIONS SUBTOTAL * ESCAL RATE
CONSTR. ESCALATION SUBTOTAL			1,461,298	
	CONTINGENCY	26.0%	379,937	ESCALATION SUBTOTAL * CONTINGENCY RATE
CONSTRUCTION GRAND TOTAL			1,841,235	

SWP FACTOR LEGEND
X= No work performed in SWP
S=Partial work performed (1.2 of labor hrs)
W= Work performed in whites (1.4 of labor hrs)
M=Work performed in whites and with mask (2.0 of labor hrs)

ESTIMATE SUMMARY
Scope of work consists of
1.) Pumping tank to remove all remaining liquid, removing all equipment (pump, jumpers, etc.).
2.) Abandon tank in place.

Escalation for WBS 1.1 & 1.3 are assumed to be same as WBS 1.2.2

PRICING JUSTIFICATION
Basis for pricing consist of reference to projects of similar nature, WS Means Estimating, and previous W-521 cdr cost estimate.

WBS #	OTHER TASKS	% OF CONSTR	Basis	Subtotal	SITE ALLOCATIONS %	Site Allocations Subtotal	ESCALATION %	Escal. Subtotal	CONTINGENCY %	Conting Subtotal	SUBTOTAL
1.1	PROJECT MANAGEMENT	5.0%	Mainly LOE effort	51,889			18.95%	9,833	10.00%	6,172	67,894
1.2	ENGINEERING										
1.2.1	DEFINITIVE DESIGN	25.0%	Full %	259,443	18%	46,700	12.98%	39,737	20.00%	69,176	368,357
1.2.2	TITLE III	8.3%	Full %	85,616	18%	15,411	18.95%	19,145	25.00%	30,043	134,804
1.2.3	STARTUP/OPERATION TEST SUPPORT	1.7%	Full %	17,642	18%	3,176	24.22%	5,042	20.00%	5,172	27,856
1.3	EXPENSE FUNDED PROJ. ACTIVITIES	12.0%	Dgn/Const/Oper sppt full %	124,533			18.95%	23,599	11.22%	16,620	164,752
1.6	STARTUP/TURNOVER	5.0%	Oper crews minimal reduct	51,889			23.64%	12,266	15.00%	9,623	73,778
										OTHER TASKS TOTAL	837,441
										GRAND TOTAL	**2,678,676**

W-521 AGA FOR AY/AZ PRIMARY VENTILATION SYSTEM AZ-702 OPTION 3

WE ID#	DESCRIPTION	WBS #	TOTAL COST	SWP	CON-TRACT TYPE	QTY	UNIT	HRS/ UNIT	HRS	LABOR COST/ HR	EQP USAGE COST/ HR (AVE = $ 5.00)	MATL COST/ UNIT	S/C COST/ UNIT	EQUIP COST/ UNIT	ADDL LABOR HRS FOR SWP WORK	LABOR	EQP USAGE	MATL	S/C	EQUIP
0102803	PIT SPECIAL PROT. COATING(AMERCOAT)FOR NEW VENT ANNEX BLDG	1520406		W	CPAF	1	EA	240.0	240	31.00	-	1,000.00		-	2,976	7,440	-	1,000	-	-
0230006	HAND EXCAV & BACKFILL / NEW VENT. BLDG ANNEX & EQUIP PADS	1520406		W	CPAF	340	CY	8.0	2,720	32.44	3.72	-		-	35,295	88,237	10,118	-	-	-
0230009	PACKAGE AND HAUL OFF CONTAMINATED SOIL	1520406		W	CPAF	340	CY	4.0	1,360	34.40	45.84	600.00			18,714	46,784	62,342	204,000	-	-
0230154	SHORING	1520406		W	CPAF	1,352	SF	0.1	180	40.00	8.90	7.38			2,877	7,193	1,600	9,978	-	-
0311003	REINFORCING BAR FOR VENT BLDG & EQUIP. PADS	1520406		W	CPAF	6	LOT		-		-		10,000		-	-	-	-	60,000	-
0311006	PROCURE OFFSITE COVER BLOCK SETS - INCLUDES ID PAINTING/VENT BLDG	1520406		X	CPAF	1	SET		-		-	63,000.00			-	-	-	63,000	-	-
0311008	CONCRETE VENTILATION ANNEX BLDG.	1520406		W	CPAF	100	CY		-				900		-	-	-	-	90,000	-
0311025	CONCRETE PAD 10X25X1	1520406		W	CPAF	1	EA	160.0	160	33.71	8.20	1,425.00			2,157	5,394	1,312	1,425	-	-
0550002	GRATING AND LADDER	1520406		S	CPAF	1	LS	192.0	192	35.75	28.65	20,000.00			1,373	6,864	5,501	20,000	-	-
1502100	INSTALL COVER BLK. SETS, VENT BLDG	1520406		S	CPAF	1	EA	450.0	450	38.35	7.73				3,452	17,258	3,479	-	-	-
1560022	10" BUTTERFLY VALVE SST INSTALL ONLY	1520406		W	CPAF	4	EA	32.0	128	46.00	4.41				2,355	5,888	564	-	-	-
1560024	KNOCK OUT VENTILATION CELL WALL (6" CONC BLOCK WALL)	1520406		M	CPAF	200	SF	10.0	2,000	35.85	6.40	72.00			71,700	71,700	12,800	14,400	-	-
1560026	DRAIN SUMP/ PUMP	1520406		W	CPAF	1	EA	80.0	80	46.00	4.41	45,000.00			1,472	3,680	353	45,000	-	-
1560028	CONDENSER, CONDENSER PIPING AND SUPPORTS	1520406		W	CPAF	1	EA	120.0	120	46.00	4.41	95,000.00			2,208	5,520	529	95,000	-	-
1560029	CHILLER W / SUPPORTS	1520406		W	CPAF	1	EA	160.0	160	46.00	4.41	72,000.00			2,944	7,360	706	72,000	-	-
1560030	HEME (HIGH EFFICIENCY MIST ELIMINATOR) W / SUPPORTS	1520406		W	CPAF	1	EA	40.0	40	46.00	4.40	81,000.00			736	1,840	176	81,000	-	-
1560034	10" SST PIPE W / FITTINGS INSTALL ONLY	1520406		M	CPAF	150	FT	20.0	3,000	46.00	4.42				138,000	138,000	13,260	-	-	-
1560038	SEAL POT W / SUPPORTS INSTALL ONLY	1520406		W	CPAF	1	EA	40.0	40	46.00	4.20	-			736	1,840	168	-	-	-
1560040	SEAL POT HOT TAP (INTO EXST SEAL POT)	1520406		M	CPAF	2	EA	32.0	64	46.00	4.40	2,000.00			2,944	2,944	282	4,000	-	-
1560044	5 HP PUMP	1520406		W	CPAF	2	EA	24.0	48	46.00	4.40	7,200.00			883	2,208	211	14,400	-	-
1560046	EXPANSION TANK	1520406		W	CPAF	1	EA	80.0	80	46.00	4.40	5,000.00			1,472	3,680	352	5,000	-	-
1560048	THERMAL EXPANSION TANK	1520406		W	CPAF	1	EA	120.0	120	42.67	11.72	40,000.00			2,048	5,120	1,406	40,000	-	-
1560050	REMOTE VALVE OPERATORS	1520406		W	CPAF	4	EA	40.0	160	46.00	4.41	20,000.00			2,944	7,360	706	80,000	-	-
1630024	MINI POWER PANEL W / SUPPORTS	1520406		W	CPAF	1	EA	16.0	16	44.00	-	5,300.00			282	704	-	5,300	-	-
1630025	MOTOR CONTROL CENTER	1520406		W	CPAF	1	EA	40.0	40	44.00	-				704	1,760	-	-	-	-
1650010	ELEC. TERMINATIONS (GROUPED BY 40 HOURS INCREMENTS)	1520406		W	CPAF	2	LOT	40.0	80	44.00	-	60.00			1,408	3,520	-	120	-	-
1650024	1 1/2" CONDUIT	1520406		W	CPAF	200	LF	0.2	36	44.00	-	7.20			634	1,584	-	1,440	-	-
1650042	#2 POWER CABLE	1520406		W	CPAF	200	LF	0.0	3	44.00	-	0.60			60	150	-	120	-	-
1680020	INSTRUMENT INSTALLATION	1520406		W	CPAF	13	EA	4.0	52	44.00	-	360.00			915	2,288	-	4,680	-	-
1560006	10" BUTTERFLY VALVE SST	151040205		X	FP	4	EA		-		-	18,000.00			-	-	-	72,000	-	-
1560006	10" SST PIPE W / FITTINGS	151040205		X	FP	150	LF		-		-	450.00			-	-	-	67,500	-	-
1560006	SEAL POT	151040205		X	FP	1	EA		-		-	14,400.00			-	-	-	14,400	-	-
N/A	RAD MONITOR	1520406		W	CPAF	1	EA	60.0	60	44.00		1,200.00			1,056	2,640	300	1,200	-	-
N/A	METAL ACCESS DOOR (TO RAD MONITOR)	1520406		W	CPAF	1	EA	40.0	40	40.00		5,000.00			640	1,600	200	5,000	-	-
N/A	CHILLED WATER PIPING W/ FITTINGS	1520406		W	CPAF	140	FT	0.85	119	42.40	8.83	14.00			2,018	5,046	1,051	1,960	-	-
N/A	CHILLED WATER SKID INSTRUMENTATION ALLOWANCE	1520406		W	CPAF	1	LOT	120.0	120	44.00		5,000.00			2,112	5,280	600	5,000	-	-
	ITEMS IN CDR EST BUT ARE NOT NECESSARY																			
0830004	DOOR W / AIRLOCK	1520406		W	CPAF	-	EA	200.0	-	37.00	19.10	45,000.00			-	-	-	-	-	-
0830005	DOOR W / AIRLOCK (INSTALLED IN EXISTING VENT BLDG.)	1520406		M	CPAF	-	EA	200.0	-	37.00	19.10	45,000.00			-	-	-	-	-	-
0850002	VIEWPORTS	1520406		W	CPAF	-	EA	16.0	-	36.00	-	7,200.00			-	-	-	-	-	-
	CPAF		1,503,919												307,114	460,880	118,016	775,023	150,000	-
	FP		153,900												-	-	-	153,900	-	-
	BASE COST SUBTOTAL		1,657,819						11,569						307,114	460,880	118,016	928,923	150,000	-

6A	SWP LABOR DOLLARS	VARIES	307,114	
6B	CONSUMABLES	4.0%	18,435	LABOR * 4% CPAF ONLY
6C	GF / FOREMAN	10.0%	76,799	(LABOR + SWP) * 10% CPAF ONLY
6D	QUALITY INSPECTION	3.0%	23,040	(LABOR + SWP) * 3% CPAF ONLY
6E	CLEANUP	8.0%	61,440	(LABOR + SWP) * 8% CPAF ONLY
6F	PERSONNEL / MATL MOVEMENT	4.0%	30,720	(LABOR + SWP) * 4% CPAF ONLY
6G	WASH ST SALES TAX	8.0%	75,789	(MATL + EQUIP + CONSUMBLS) * 8%
ODC'S			593,337	
7A	FP SUBCONTRACTOR MARKUP	10.0%	-	S/C * 10% FP ONLY
7B	FP CONTRACTOR MARKUP	42.0%	64,636	(LABOR + EQP USAGE + MATL + EQUIP) * 42% FP ONLY
7C	FP CM	22.0%	33,858	(LABOR + EQP USAGE + MATL + S/C + EQUIP) * 22% FP ONLY
7D	CF CM	36.0%	727,728	(BASE COST SUBTOTAL + SWP + CONSUMBLS + GF/F + QUAL INSP + CLEANUP + MATL MVMT) * 36% CPAF ONLY
CONTRACTOR MKUP & CM SUBTOTAL			826,224	
ESTIMATE SUBTOTAL			3,077,380	
7E	GOVT EQUIP SURCHARGE	5.0%	38,400	(LABOR + SWP) * 5% CPAF ONLY
7F	SHARED SERVICES & PHMC G&A	18.0%	553,928	ESTIMATE SUBTOTAL * 18%
SITE ALLOCATIONS SUBTOTAL			3,669,708	
	ESCALATION	18.18%	667,153	SITE ALLOCATIONS SUBTOTAL * ESCAL RATE
CONSTR. ESCALATION SUBTOTAL			4,336,861	
	CONTINGENCY	26.0%	1,127,584	ESCALATION SUBTOTAL * CONTINGENCY RATE
CONSTRUCTION GRAND TOTAL			5,464,444	

SWP FACTOR LEGEND
X= No work performed in SWP
S=Partial work performed (1.2 of labor hrs)
W= Work performed in whites (1.4 of labor hrs)
M=Work performed in whites and with mask (2.0 of labor hrs)

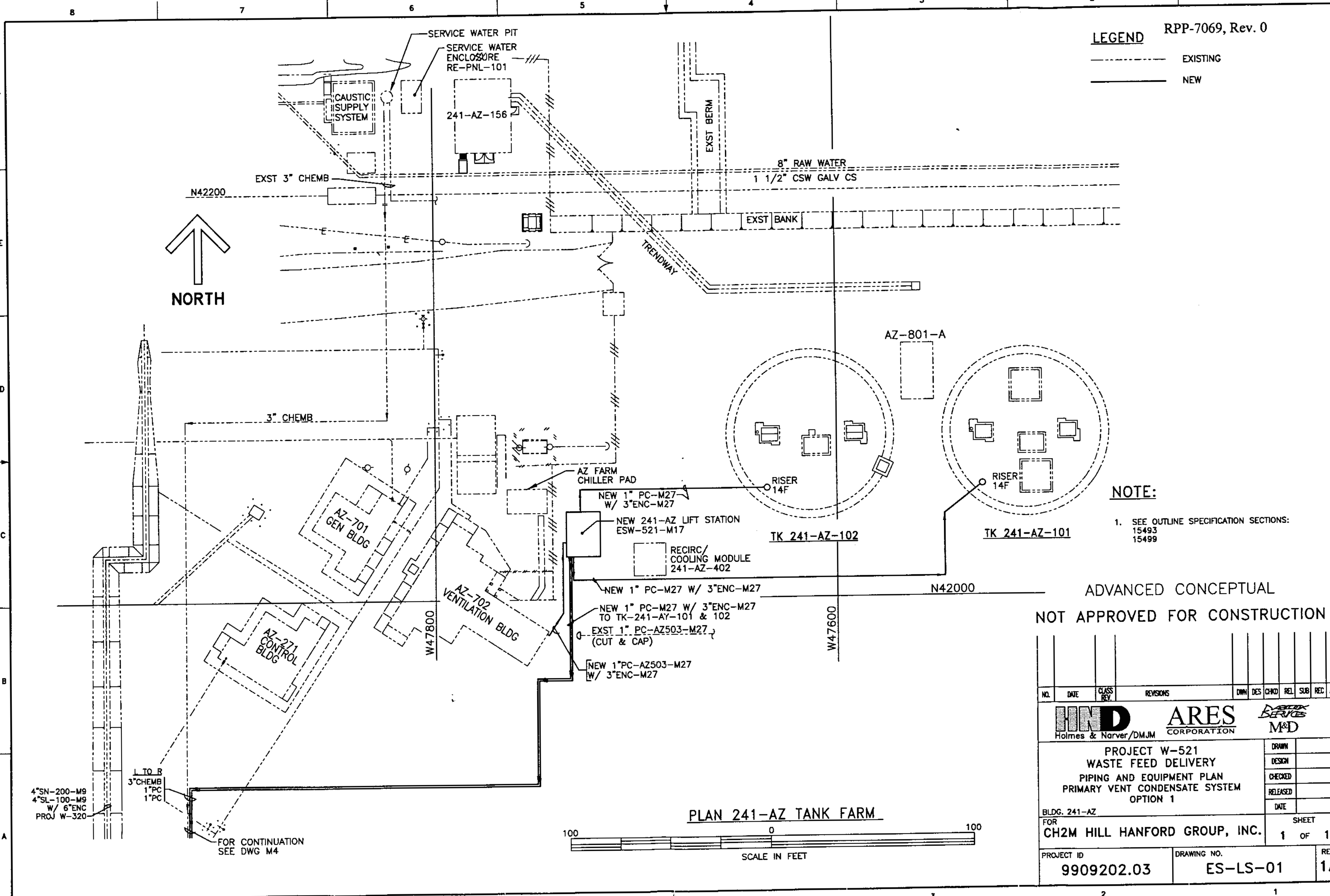
ESTIMATE SUMMARY
Scope of work consists of
1.) Pumping tank to remove all remaining liquid, removing all equipment (pump, jumpers, etc.).
2.) Abandon tank in place.

Escalation for WBS 1.1 & 1.3 are assumed to be same as WBS 1.2.2

PRICING JUSTIFICATION
Basis for pricing consist of reference to projects of similar nature, WS Means Estimating, and previous W-521 cdr cost estimate.

WBS #	OTHER TASKS	% OF CONSTR	Basis	Subtotal	SITE ALLOCATIONS %	SITE ALLOCATIONS Site Allocations Subtotal	ESCALATION %	ESCALATION Escal. Subtotal	CONTINGENCY %	CONTINGENCY Conting Subtotal	SUBTOTAL
1.1	PROJECT MANAGEMENT	5.0%	Mainly LOE effort	153,869			18.95%	29,158	10.00%	18,303	201,330
1.2	ENGINEERING										
1.2.1	DEFINITIVE DESIGN	25.0%	Full %	769,345	18%	138,482	12.98%	117,836	20.00%	205,133	1,092,313
1.2.2	TITLE III	8.3%	Full %	253,884	18%	45,699	18.95%	56,771	25.00%	89,068	399,743
1.2.3	STARTUP/OPERATION TEST SUPPORT	1.7%	Full %	52,315	18%	9,417	24.22%	14,952	20.00%	15,337	82,604
1.3	EXPENSE FUNDED PROJ. ACTIVITIES	12.0%	Dgn/Const/Oper sppt full %	369,286			18.95%	69,980	11.22%	49,286	488,551
1.6	STARTUP/TURNOVER	5.0%	Oper crews minimal reduct	153,869			23.64%	36,375	15.00%	28,537	218,780
										OTHER TASKS TOTAL	2,483,321
										GRAND TOTAL	**7,947,766**

Appendix B
Sketches of Options for Returning Condensate to the 241-AY and 241-AZ Tanks


LEGEND
EXISTING
NEW
SERVICE WATER PIT
SERVICE WATER ENCLOSURE RE-PNL-101
CAUSTIC SUPPLY SYSTEM
241-AZ-156
EXST BERM
8" RAW WATER
1 1/2" CSW GALV CS
EXST 3" CHEMB
N42200
EXST BANK
TRENDWAY
NORTH
AZ-801-A
3" CHEMB
AZ FARM CHILLER PAD
RISER 14F
RISER 14F
NOTE:
1. SEE OUTLINE SPECIFICATION SECTIONS: 15493 15499
NEW 1" PC-M27 W/ 3"ENC-M27
NEW 241-AZ LIFT STATION ESW-521-M17
RECIRC/ COOLING MODULE 241-AZ-402
TK 241-AZ-102
TK 241-AZ-101
AZ-701 GEN BLDG
AZ-702 VENTILATION BLDG
AZ-271 CONTROL BLDG
W47800
W47600
N42000
NEW 1" PC-M27 W/ 3"ENC-M27
NEW 1" PC-M27 W/ 3"ENC-M27 TO TK-241-AY-101 & 102
EXST 1" PC-AZ503-M27 (CUT & CAP)
NEW 1"PC-AZ503-M27 W/ 3"ENC-M27
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
L TO R 3"CHEMB 1"PC 1"PC
4"SN-200-M9 4"SL-100-M9 W/ 6"ENC PROJ W-320
FOR CONTINUATION SEE DWG M4
PLAN 241-AZ TANK FARM
100 0 100
SCALE IN FEET
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
PIPING AND EQUIPMENT PLAN
PRIMARY VENT CONDENSATE SYSTEM
OPTION 1
DRAWN DESIGN CHECKED RELEASED DATE
BLDG. 241-AZ
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1
PROJECT ID 9909202.03
DRAWING NO. ES-LS-01
REV. 1A

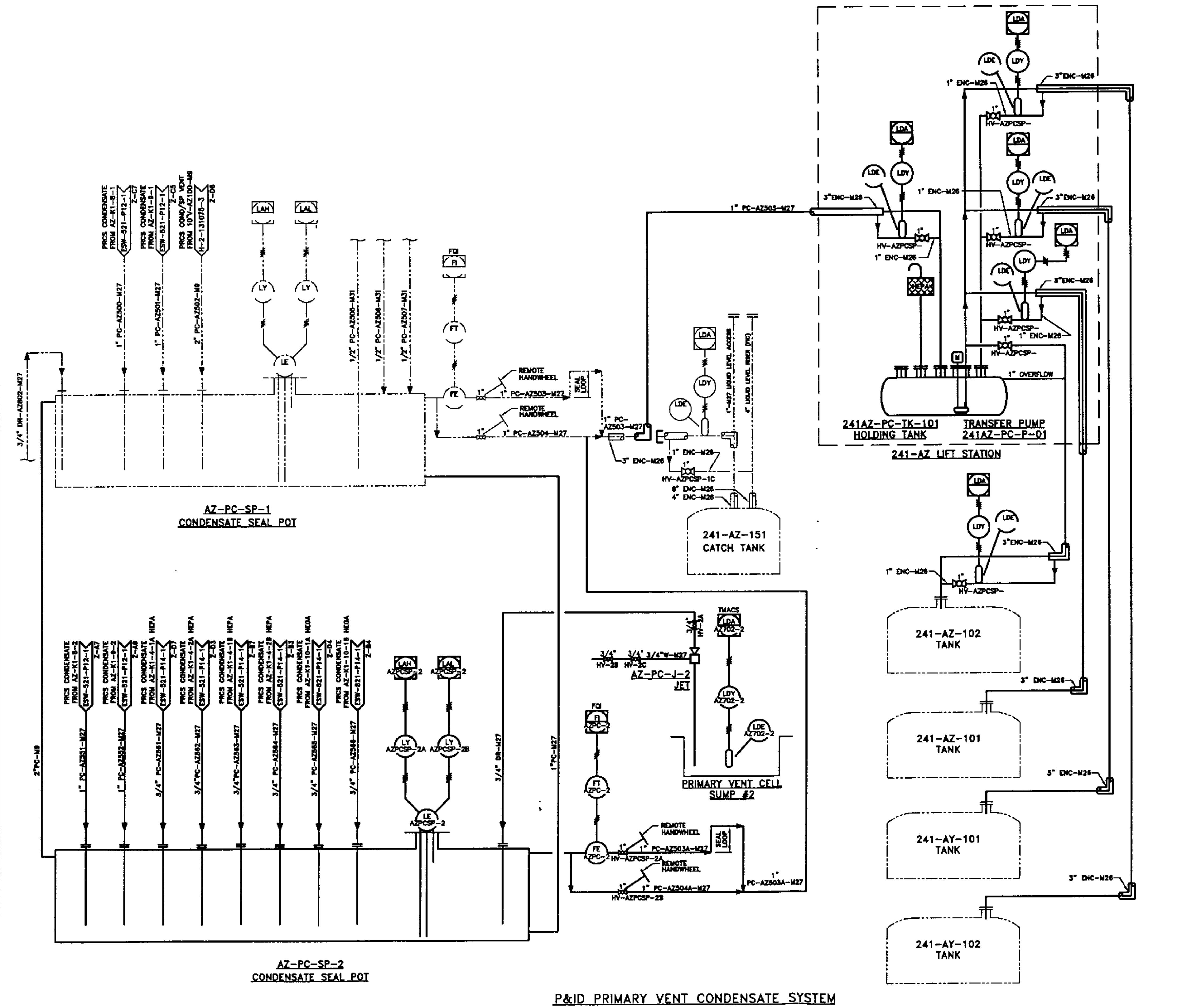
LEGEND

EXISTING

NEW (W-521)

NOTE:

1. THIS DRAWING DOES NOT INCLUDE ALL EXISTING EQUIPMENT AND INSTRUMENTATION.



P&ID PRIMARY VENT CONDENSATE SYSTEM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM | ARES CORPORATION | M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL P&ID
PRIMARY VENT CONDENSATE SYSTEM
OPTION 1

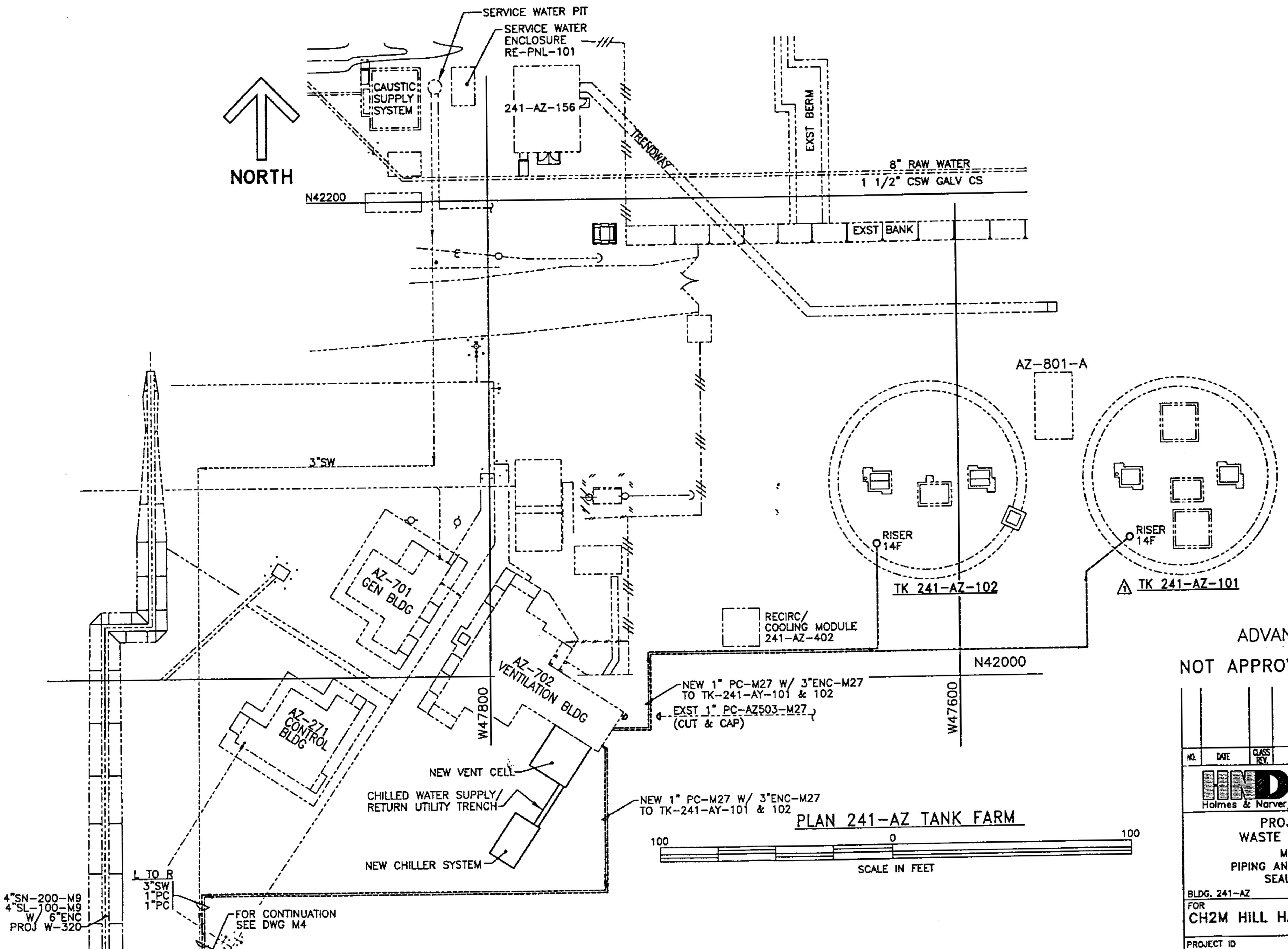
BLDG. 241-AZ-702

FOR
CH2M HILL HANFORD GROUP, INC.

DRAWN / DESIGN / CHECKED / RELEASED / DATE

SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ES-LS-02 | REV. 1A



NOTE:

1. SEE OUTLINE SPECIFICATION SECTIONS: 15493 15499

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
PIPING AND EQUIPMENT PLAN
SEAL POT OPTION

DRAWN / DESIGN / CHECKED / RELEASED / DATE

BLDG. 241-AZ

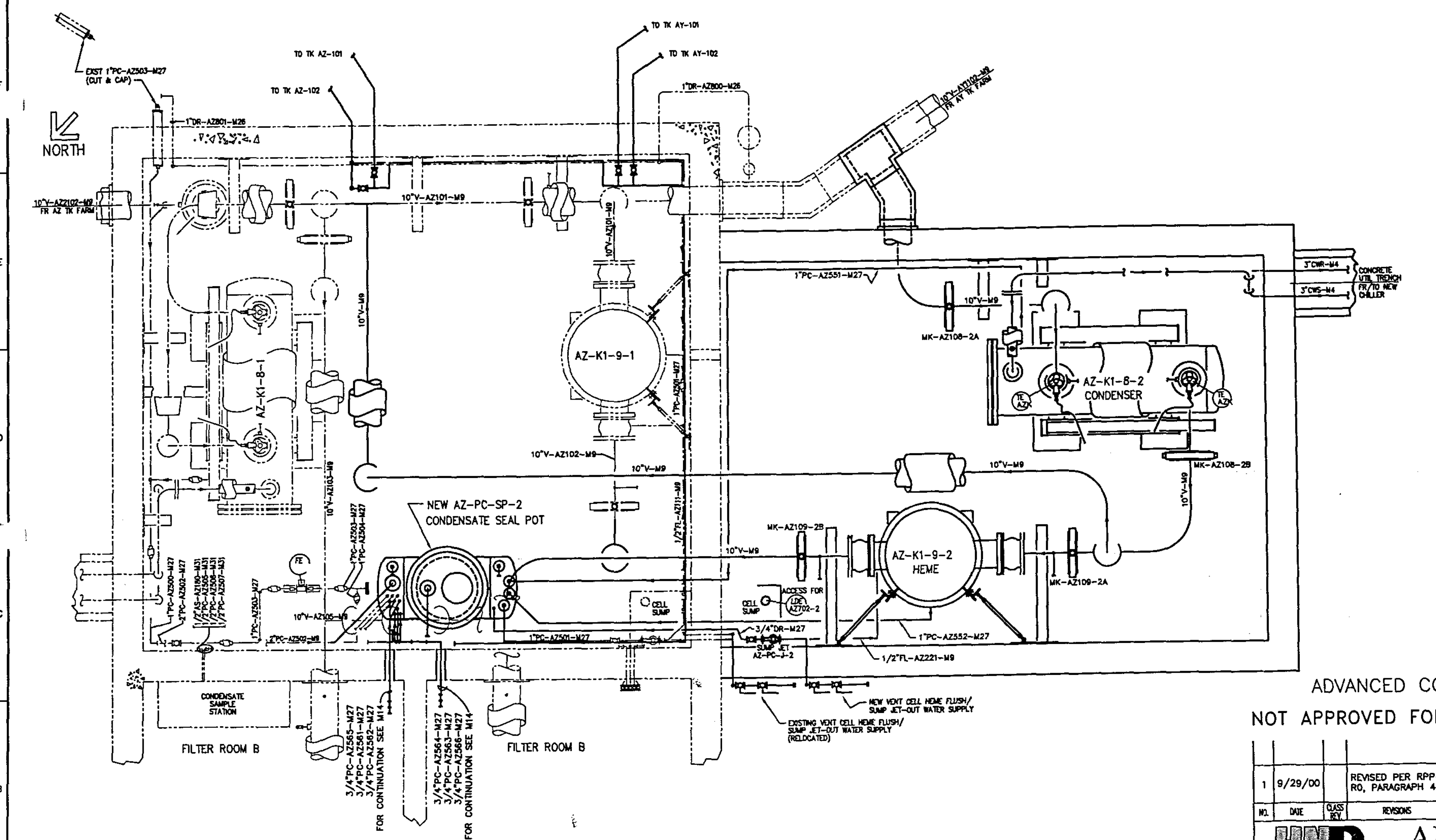
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ES-SP-01

REV. 1A



PLAN
CEILINGS AND COVER BLOCKS NOT SHOWN

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.3	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL PLAN
PRIMARY VENT CONDENSATE SYSTEM
SEAL POT OPTION

DRAWN / DESIGN / CHECKED / RELEASED / DATE

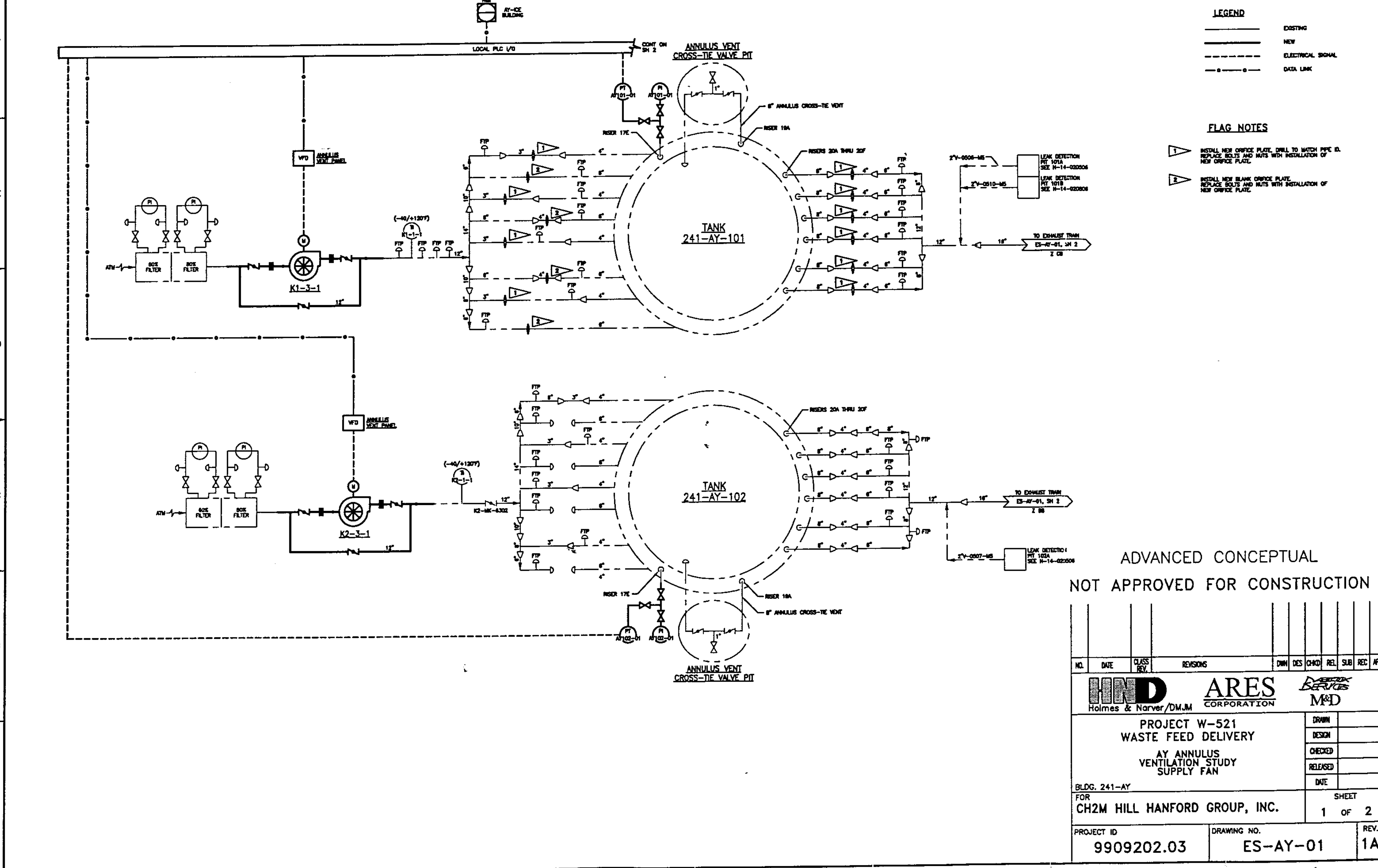
BLDG. 241-AZ-702

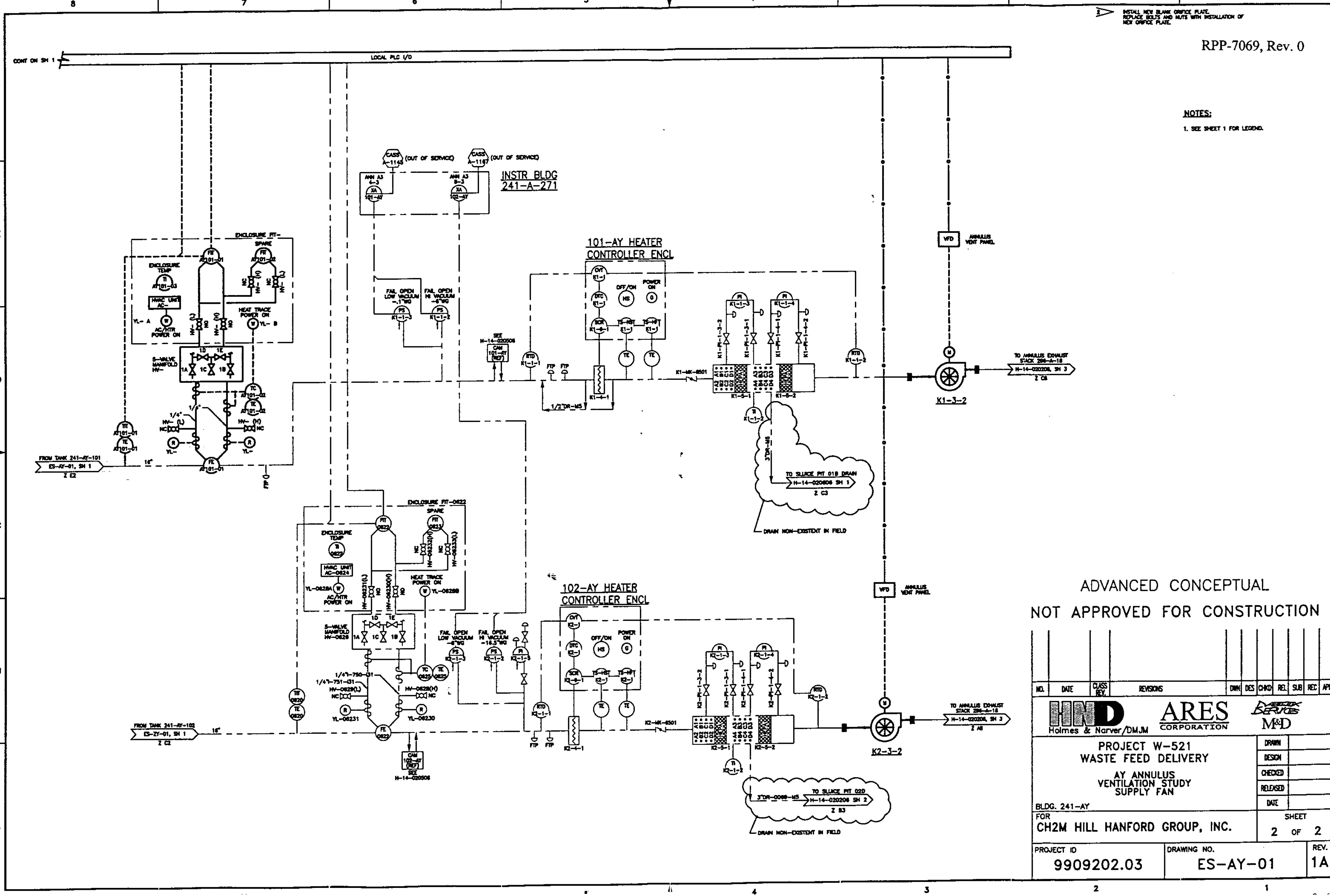
FOR CH2M HILL HANFORD GROUP, INC.

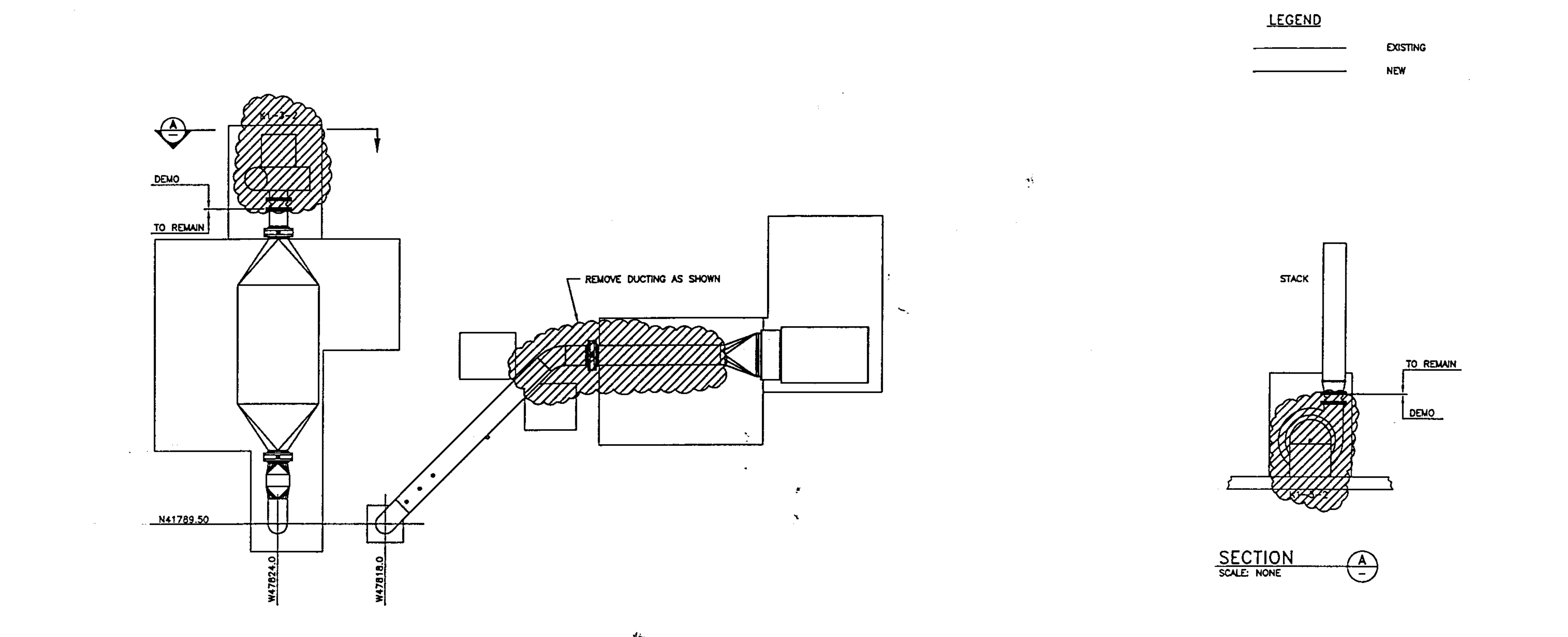
SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ES-SP-02 | REV. 1A

Appendix C
Sketches of 241-AY Annulus Ventilation Systems Modifications to Achieve Higher Flow Rates


LEGEND
EXISTING
NEW
ELECTRICAL SIGNAL
DATA LINK
FLAG NOTES
INSTALL NEW ORIFICE PLATE. DRILL TO MATCH PIPE ID. REPLACE BOLTS AND NUTS WITH INSTALLATION OF NEW ORIFICE PLATE.
INSTALL NEW BLANK ORIFICE PLATE. REPLACE BOLTS AND NUTS WITH INSTALLATION OF NEW ORIFICE PLATE.
LOCAL PLC I/O
CONT ON SH 2
ANNULUS VENT CROSS-TIE VALVE PIT
TANK 241-AY-101
TANK 241-AY-102
K1-3-1
K2-3-1
VFD
ANNULUS VENT PANEL
BOX FILTER
ATM
RISER 17E
RISER 19A
RISERS 20A THRU 20F
8" ANNULUS CROSS-TIE VENT
TO EXHAUST TRAIN ES-AY-01, SH 2
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
AY ANNULUS VENTILATION STUDY SUPPLY FAN
DRAWN
DESIGN
CHECKED
RELEASED
DATE
BLDG. 241-AY
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 2
PROJECT ID 9909202.03
DRAWING NO. ES-AY-01
REV. 1A


INSTALL NEW BLANK ORIFICE PLATE. REPLACE BOLTS AND NUTS WITH INSTALLATION OF NEW ORIFICE PLATE.
NOTES:
1. SEE SHEET 1 FOR LEGEND.
CONT ON SH 1
LOCAL PLC I/O
INSTR BLDG 241-A-271
(OUT OF SERVICE)
101-AY HEATER CONTROLLER ENCL
102-AY HEATER CONTROLLER ENCL
ENCLOSURE PIT-SPARE
ENCLOSURE PIT-0822
ENCLOSURE TEMP
HVAC UNIT
AC/HTR POWER ON
HEAT TRACE POWER ON
5-VALVE MANIFOLD
FAIL OPEN LOW VACUUM
FAIL OPEN HI VACUUM
OFF/ON
POWER ON
ANNULUS VENT PANEL
VFD
K1-3-2
K2-3-2
TO ANNULUS EXHAUST STACK 296-A-18
TO SLUICE PIT 01B DRAIN
TO SLUICE PIT 02D
DRAIN NON-EXISTENT IN FIELD
FROM TANK 241-AY-101
FROM TANK 241-AY-102
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
AY ANNULUS
VENTILATION STUDY
SUPPLY FAN
BLDG. 241-AY
FOR
CH2M HILL HANFORD GROUP, INC.
DRAWN
DESIGN
CHECKED
RELEASED
DATE
SHEET 2 OF 2
PROJECT ID 9909202.03
DRAWING NO. ES-AY-01
REV. 1A



PLAN – AY-101 ANNULUS VENTILATION SUPPLY AND EXHAUST

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

VENTILATION
AY ANNULUS SUPPLY AND EXHAUST
TK-101 EXISTING LAYOUT/DEMOLITION

BLDG. 241-AY

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN / DESIGN / CHECKED / RELEASED / DATE

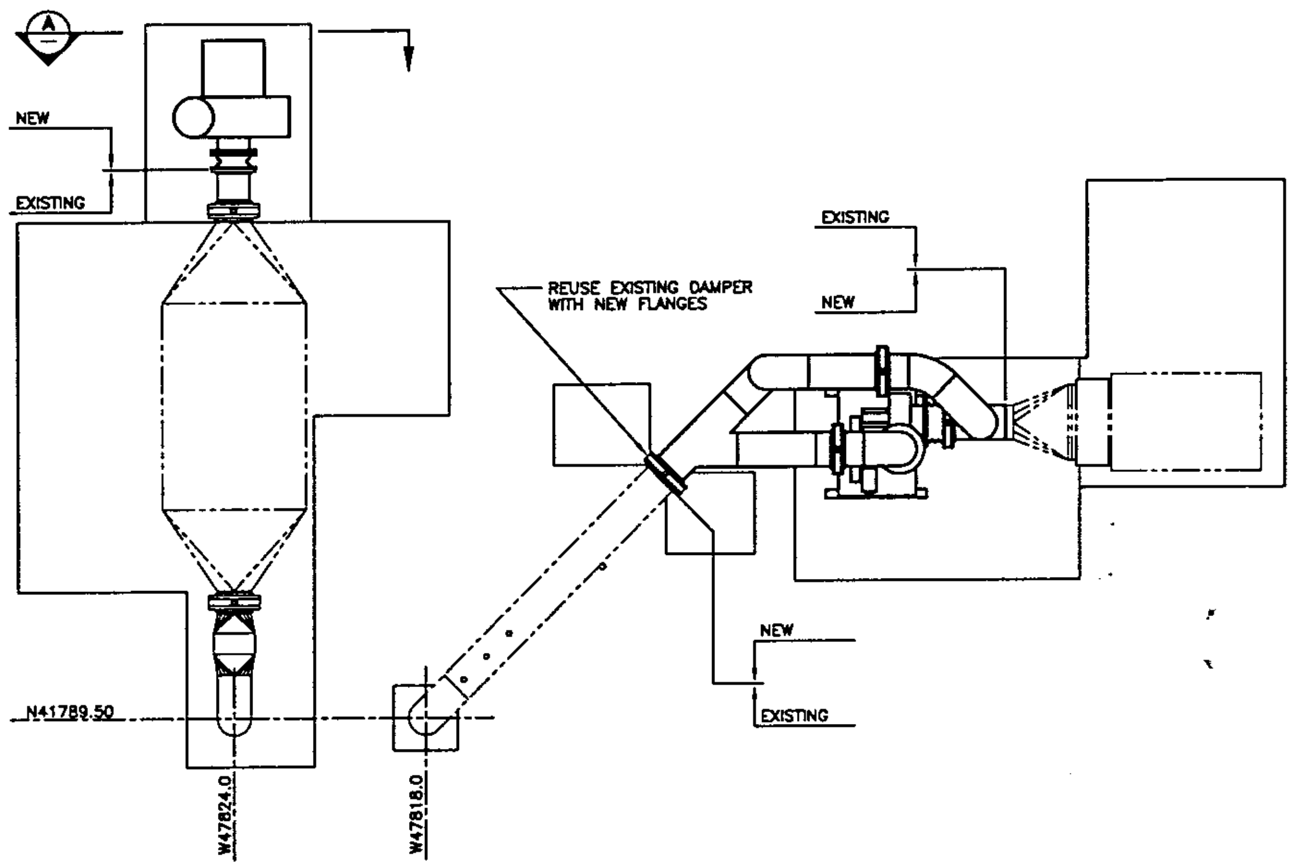
SHEET 1 OF 4

PROJECT ID 9909202.03 | DRAWING NO. ES-AY-02 | REV. 1A

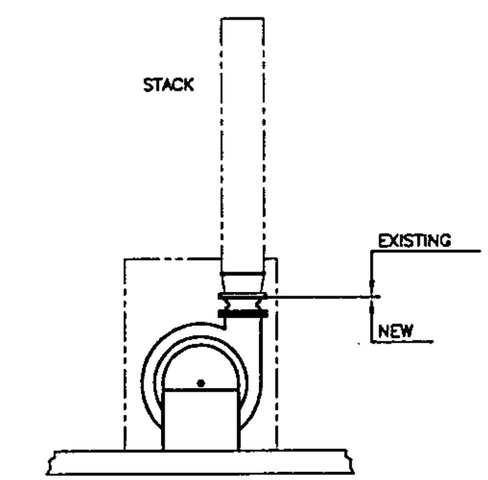
LEGEND

EXISTING

NEW



PLAN – AY-101 ANNULUS VENTILATION SUPPLY AND EXHAUST



SECTION (A)
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM ARES CORPORATION M&D

PROJECT W-521
WASTE FEED DELIVERY

VENTILATION
AY ANNULUS SUPPLY AND EXHAUST
TK-101 EQUIPMENT LAYOUT

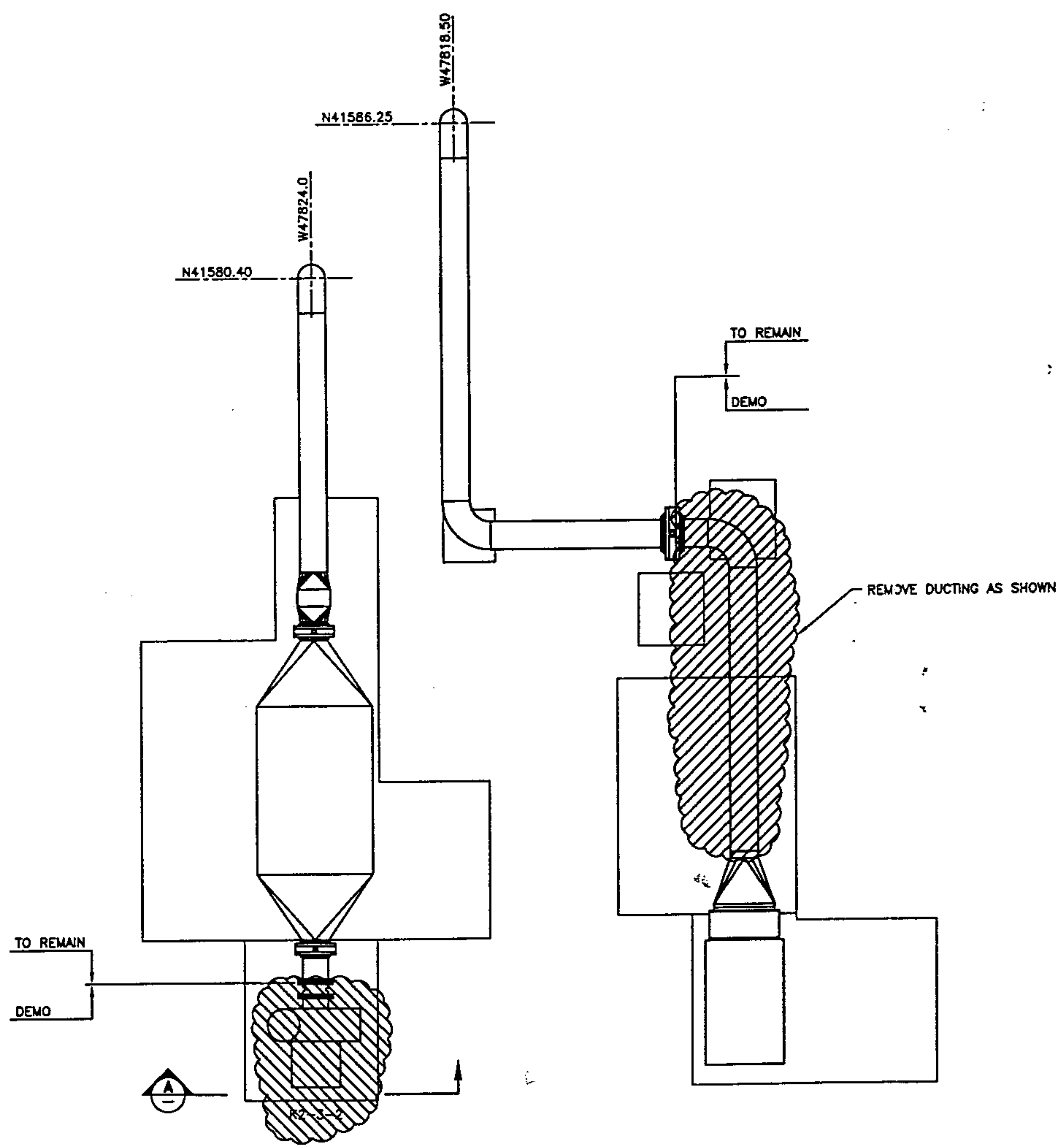
BLDG. 241-AY

DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 2 OF 4

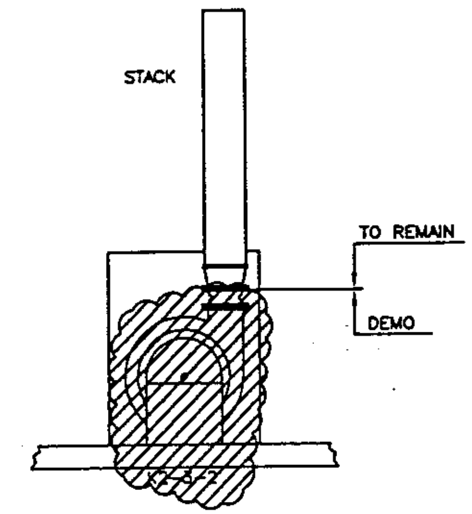
PROJECT ID	DRAWING NO.	REV.
9909202.03	ES-AY-02	1A



PLAN - AY-102 ANNULUS VENTILATION SUPPLY AND EXHAUST

LEGEND

- - - -	EXISTING
——	NEW



SECTION A
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

VENTILATION
AY ANNULUS SUPPLY AND EXHAUST
TK-102 EXISTING LAYOUT/DEMOLITION

BLDG. 241-AY

FOR CH2M HILL HANFORD GROUP, INC.

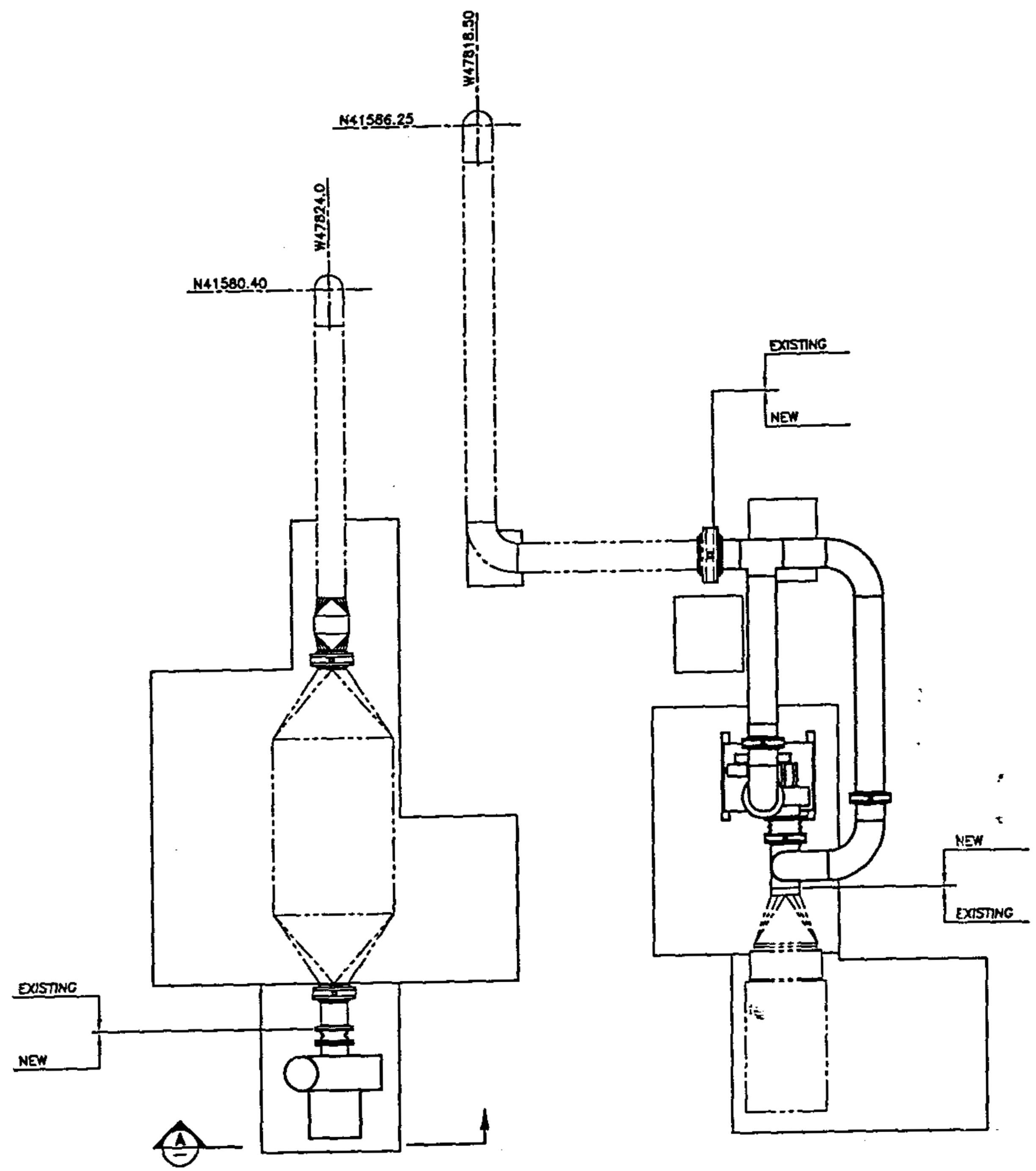
DRAWN / DESIGN / CHECKED / RELEASED / DATE

SHEET 3 OF 4

PROJECT ID 9909202.03

DRAWING NO. ES-AY-02

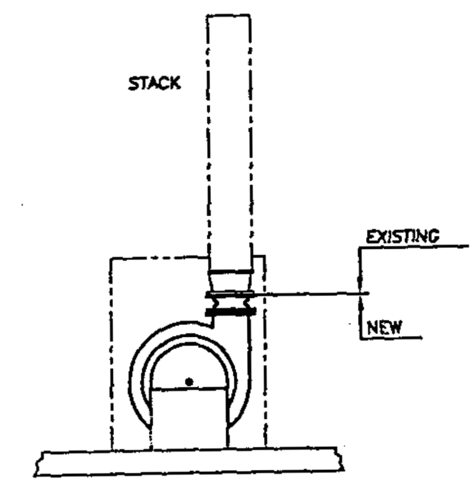
REV. 1A



PLAN - AY-102 ANNULUS VENTILATION SUPPLY AND EXHAUST

LEGEND

- - - - -	EXISTING
———	NEW



SECTION (A)
SCALE: NONE

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

VENTILATION
AY ANNULUS SUPPLY AND EXHAUST
TK-102 EQUIPMENT LAYOUT

BLDG. 241-AY

FOR CH2M HILL HANFORD GROUP, INC.

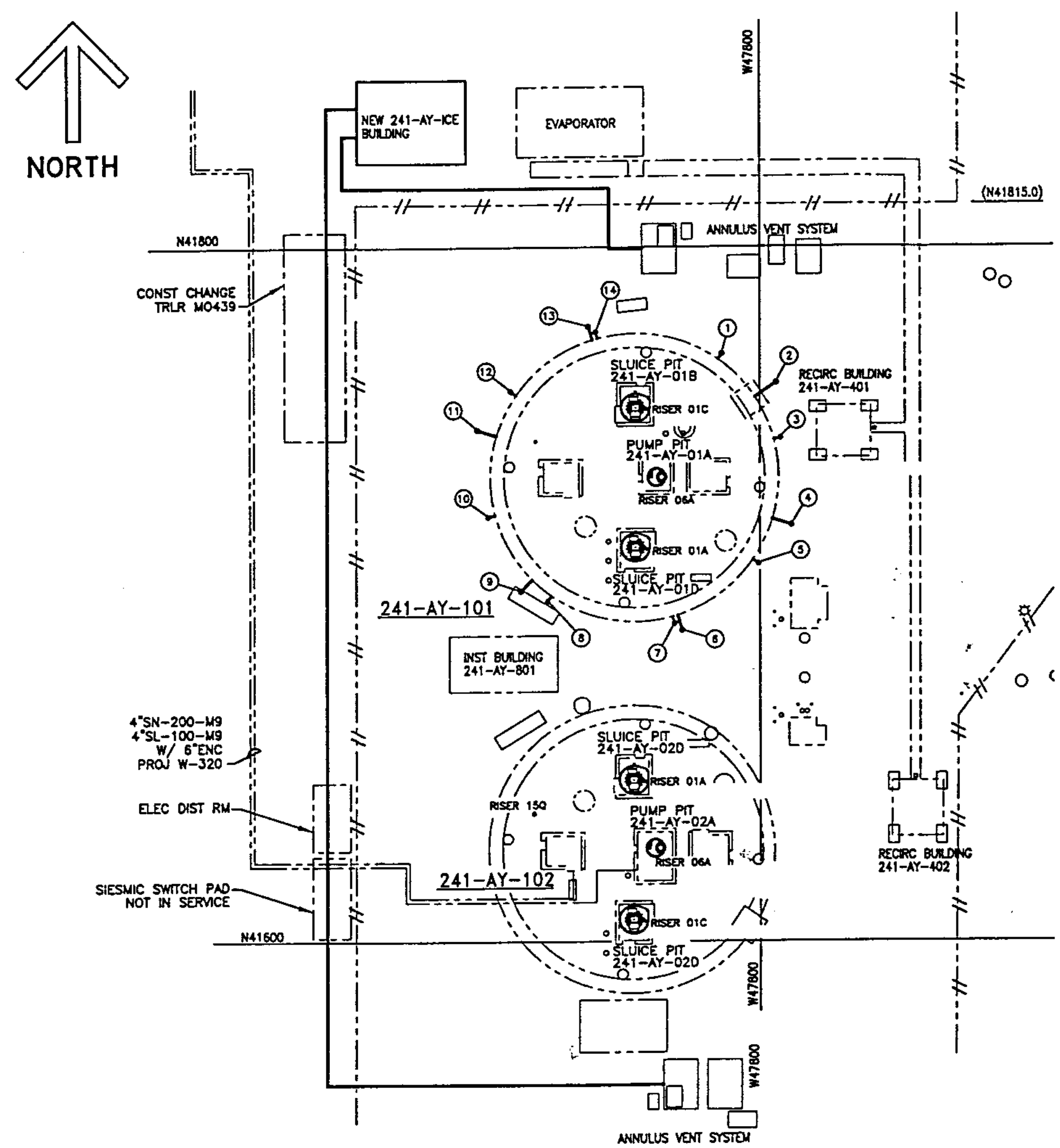
DRAWN / DESIGN / CHECKED / RELEASED / DATE

SHEET 4 OF 4

PROJECT ID 9909202.03

DRAWING NO. ES-AY-02

REV. 1A



PLAN 241-AY TANK FARM

LEGEND

- - - - - EXISTING

——— NEW

NOTES:

1. REFER TO DWG ESW-521-M4 FOR ADDITIONAL TRENCHING REQUIREMENTS.
2. APPROXIMATE LENGTH OF CABLE RUNS ARE 400' AND 125'.
3. INSTALL NEW ORIFICE PLATE, DRILL TO MATCH PIPE ID. INSTALL NEW BOLTS AND NUTS WITH INSTALLATION OF NEW ORIFICE PLATE.
4. INSTALL NEW BLANK ORIFICE PLATE. INSTALL NEW BOLTS AND NUTS WITH INSTALLATION OF NEW ORIFICE PLATE.

ORIFICE ID	S-SUPPLY E-EXHAUST	PIPE SIZE	ORIFICE PLATE	DEPTH BELOW GRADE
1	S	4"	NOTE 4	12.5'
2	E	4"	NOTE 3	12.5'
3	S	3"	NOTE 3	8'
4	E	4"	NOTE 3	12.5'
5	S	6"	NOTE 4	14'
6	E	4"	NOTE 3	14'
7	S	3"	NOTE 3	14.5'
8	S	6"	NOTE 4	8'
9	E	4"	NOTE 3	13'
10	S	3"	NOTE 3	9'
11	E	4"	NOTE 3	11.5'
12	S	4"	NOTE 4	12.5'
13	E	4"	NOTE 3	13'
14	S	3"	NOTE 3	8'

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HNMD Holmes & Narver/DMJM — ARES CORPORATION — Duratek Services M&D

PROJECT W-521
WASTE FEED DELIVERY

AY ANNULUS
VENTILATION STUDY
SITE PLAN/EXCAVATION

DRAWN / DESIGN / CHECKED / RELEASED / DATE

BLDG. 241-AY

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03

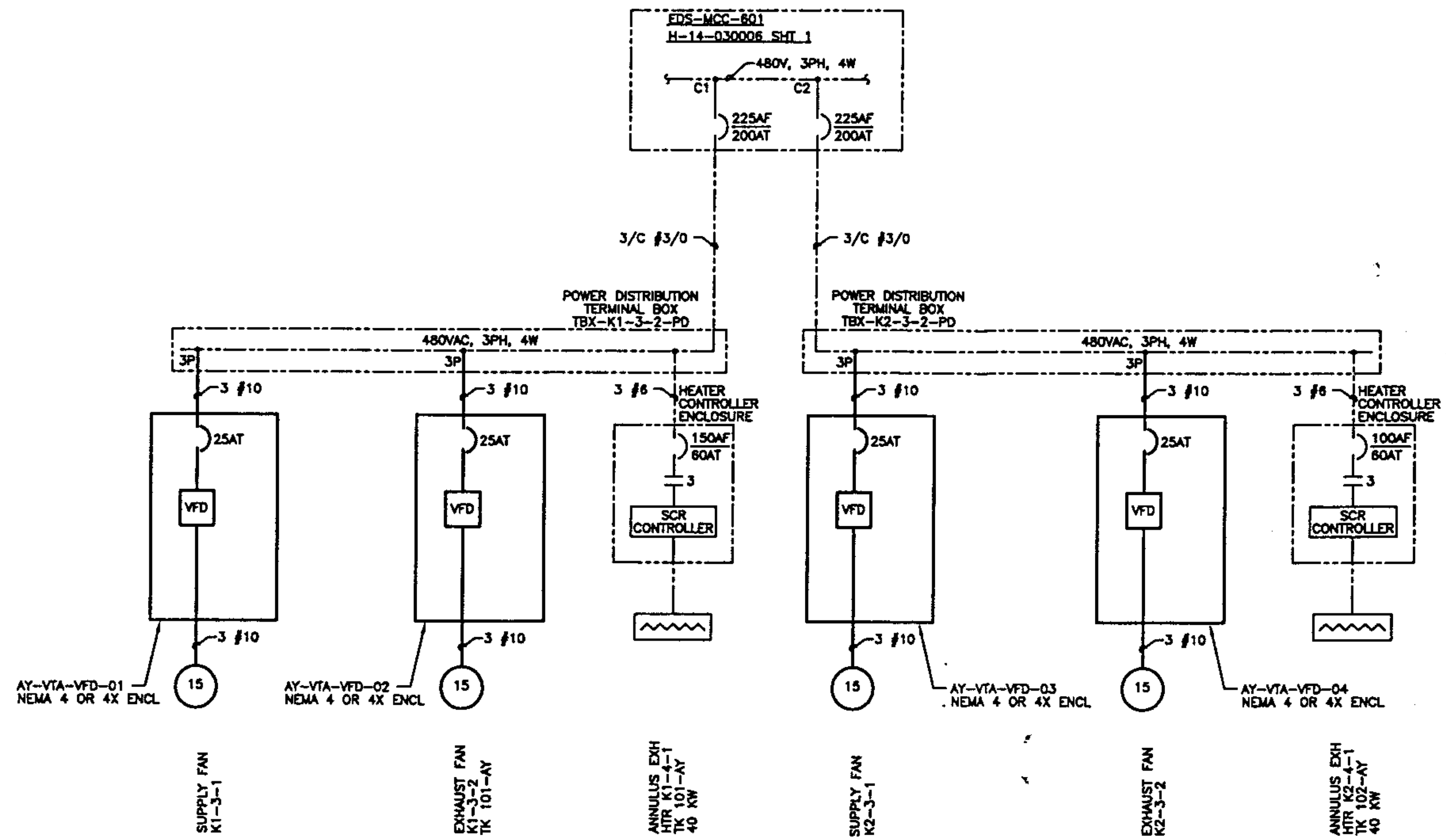
DRAWING NO. ES-AY-03

REV. 1A

LEGEND

EXISTING

NEW



AY ANNULUS VENTILATION ONE LINE DIAGRAM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-AY ANNULUS

BLDG. 241-AY

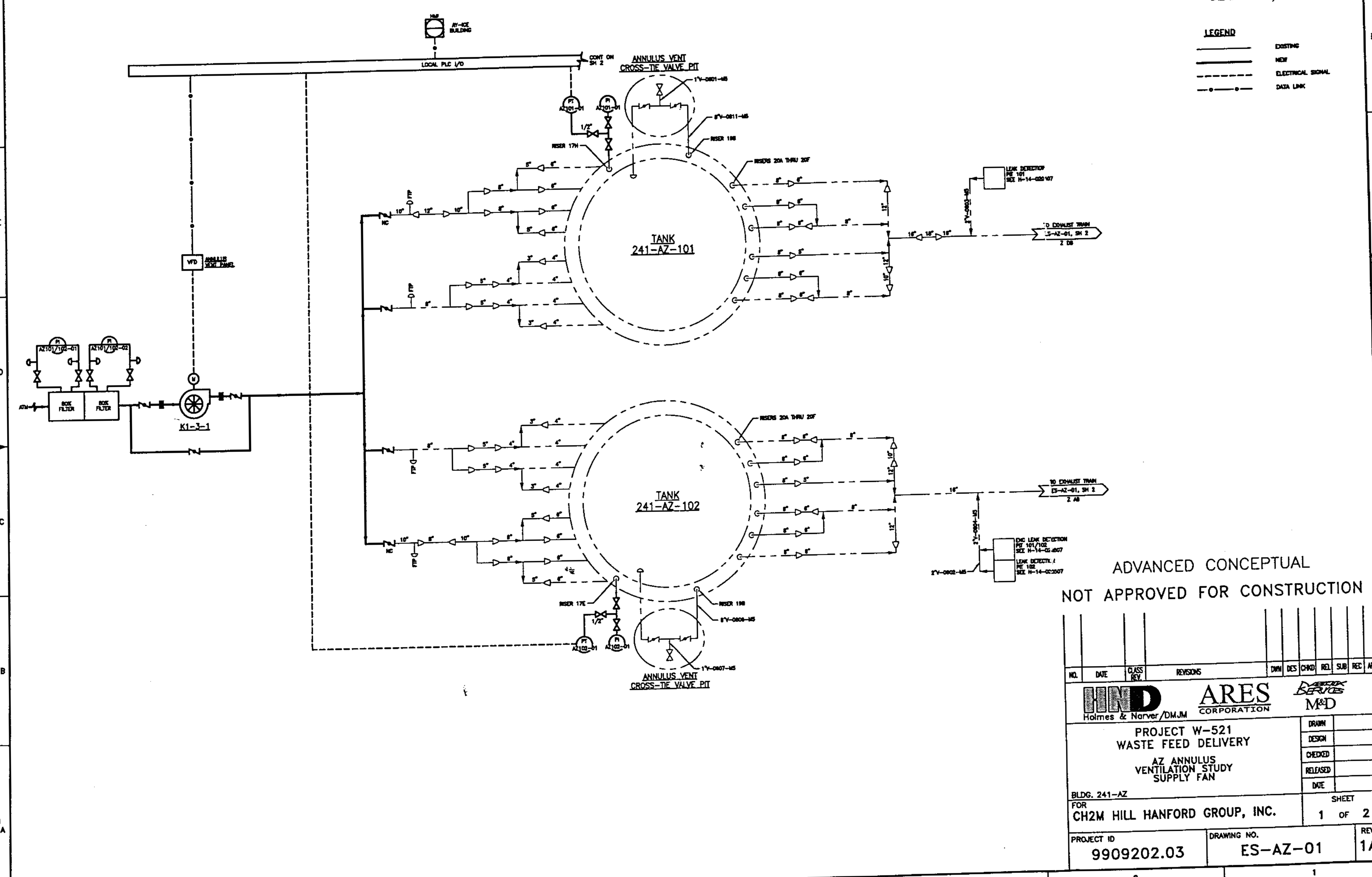
FOR CH2M HILL HANFORD GROUP, INC.

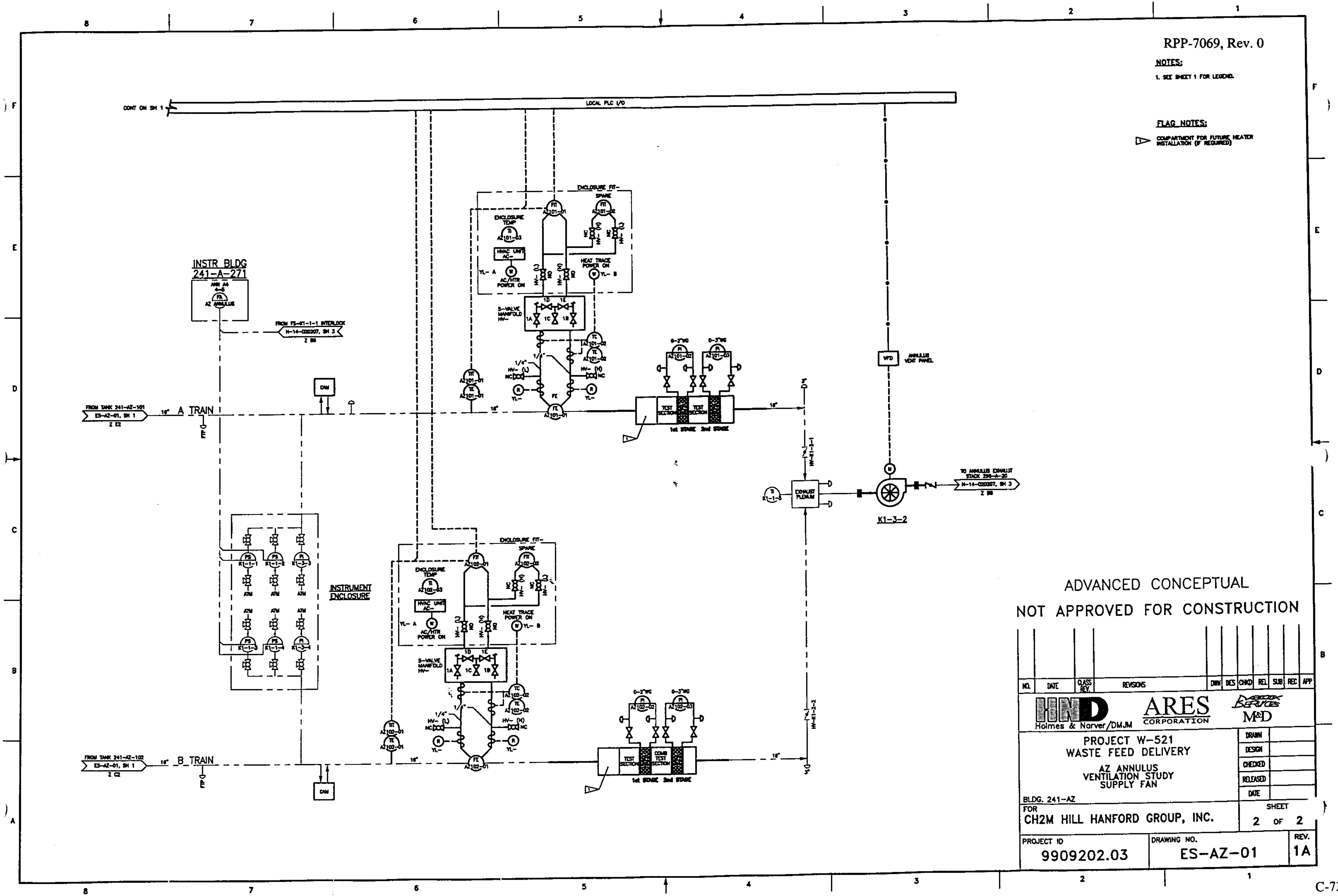
DRAWN	R.E. WILSON
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

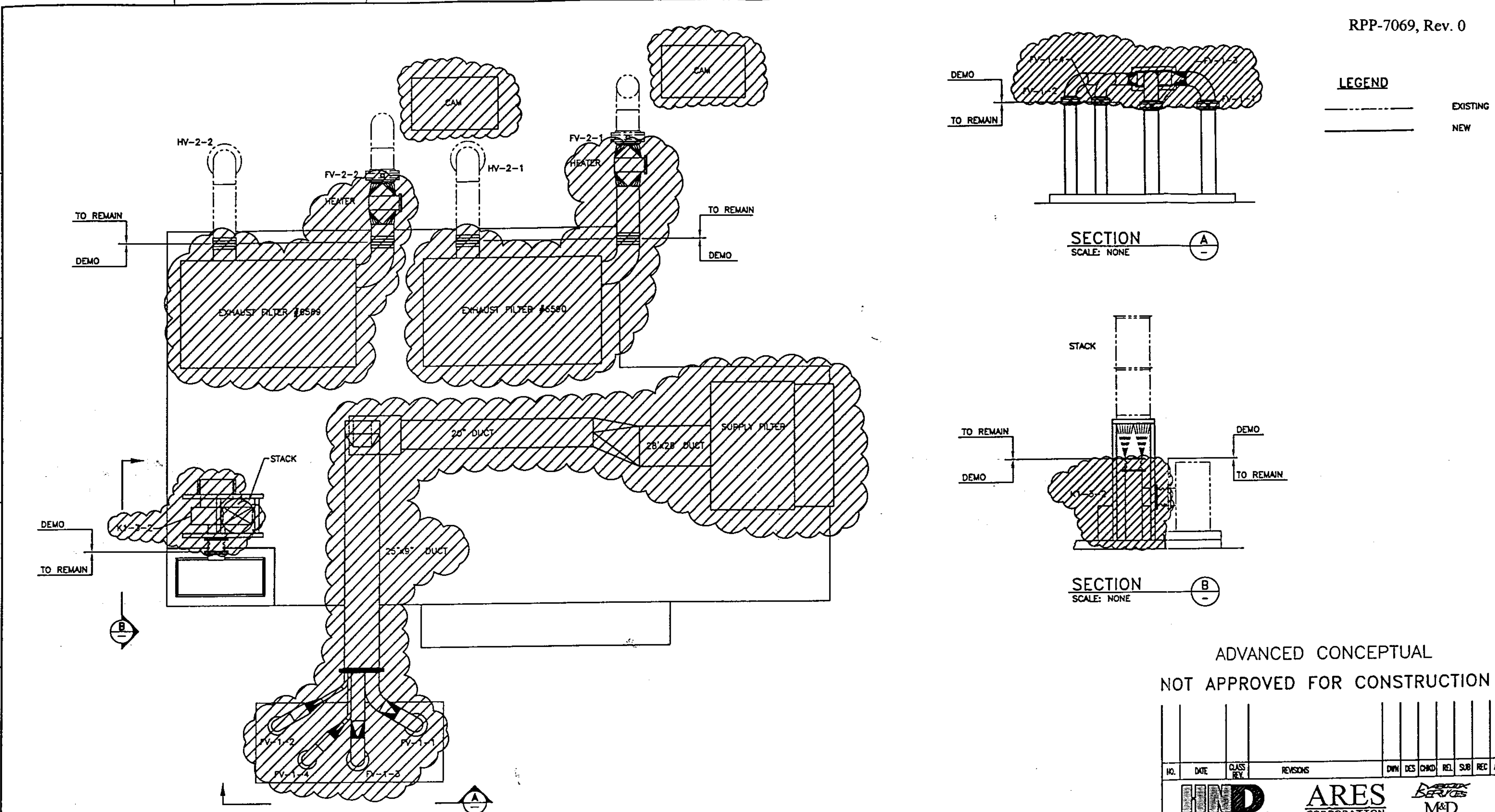
SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ES-AY-04	1A

Appendix D
Sketches of 241-AZ Annulus Ventilation System Modifications to Achieve Higher Flow Rates


LEGEND
EXISTING
NEW
ELECTRICAL SIGNAL
DATA LINK
AY-ICE BUILDING
LOCAL PLC I/O
CONT ON SH 2
ANNULUS VENT CROSS-TIE VALVE PIT
VFD
ANNULUS VENT PANEL
BOX FILTER
BOX FILTER
K1-3-1
TANK 241-AZ-101
TANK 241-AZ-102
RISERS 20A THRU 20F
RISER 17H
RISER 19B
RISER 17E
TO EXHAUST TRAIN ES-AZ-01, SH 2
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
NO.
DATE
CLASS REV.
REVISIONS
DWN
DES
CHKD
REL
SUB
REC
APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
AZ ANNULUS
VENTILATION STUDY
SUPPLY FAN
DRAWN
DESIGN
CHECKED
RELEASED
DATE
BLDG. 241-AZ
FOR
CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 2
PROJECT ID
9909202.03
DRAWING NO.
ES-AZ-01
REV.
1A


NOTES:
1. SEE SHEET 1 FOR LEGEND.
FLAG NOTES:
COMPARTMENT FOR FUTURE HEATER INSTALLATION (IF REQUIRED)
CONT ON SH 1
LOCAL PLC I/O
INSTR BLDG
241-A-271
AZ ANNULUS
FROM FS-K1-1-1 INTERLOCK
H-14-020207, SH 3
FROM TANK 241-AZ-101
ES-AZ-01, SH 1
A TRAIN
FROM TANK 241-AZ-102
ES-AZ-01, SH 1
B TRAIN
INSTRUMENT ENCLOSURE
ENCLOSURE FIT-SPARE
ENCLOSURE TEMP
HVAC UNIT AC-
AC/HTR POWER ON
HEAT TRACE POWER ON
5-VALVE MANIFOLD HV-
TEST SECTION
COMB TEST SECTION
1st STAGE
2nd STAGE
EXHAUST PLENUM
VFD
ANNULUS VENT PANEL
K1-3-2
TO ANNULUS EXHAUST STACK 296-A-20
H-14-020207, SH 3
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
NO.
DATE
CLASS REV.
REVISIONS
DWN
DES
CHKD
REL
SUB
REC
APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
AZ ANNULUS
VENTILATION STUDY
SUPPLY FAN
DRAWN
DESIGN
CHECKED
RELEASED
DATE
BLDG. 241-AZ
FOR
CH2M HILL HANFORD GROUP, INC.
SHEET
2 OF 2
PROJECT ID
9909202.03
DRAWING NO.
ES-AZ-01
REV.
1A



PLAN - AZ ANNULUS VENTILATION SUPPLY AND EXHAUST

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
VENTILATION
AZ ANNULUS SUPPLY AND EXHAUST
EXISTING LAYOUT/DEMOLITION

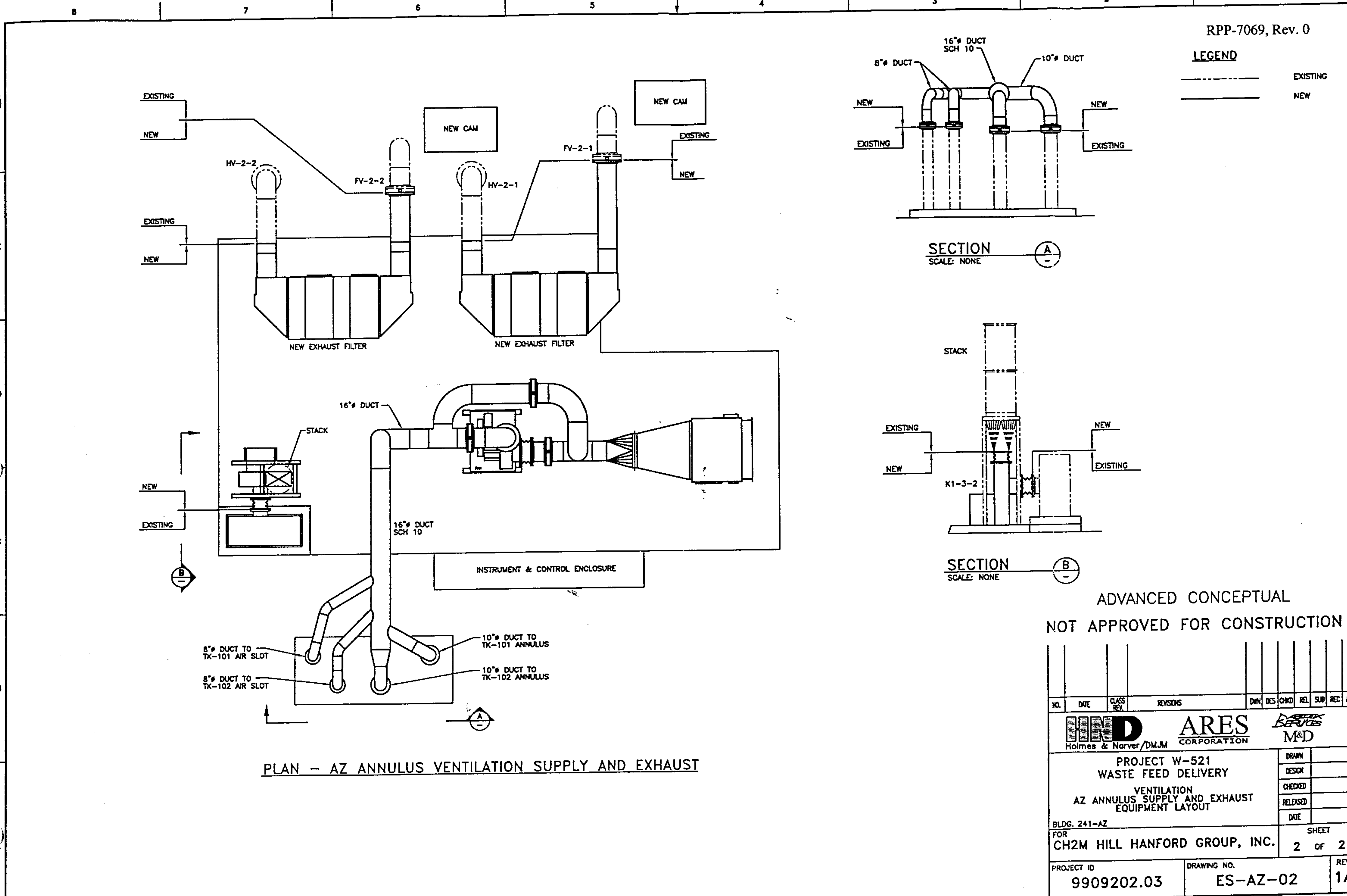
BLDG. 241-AZ

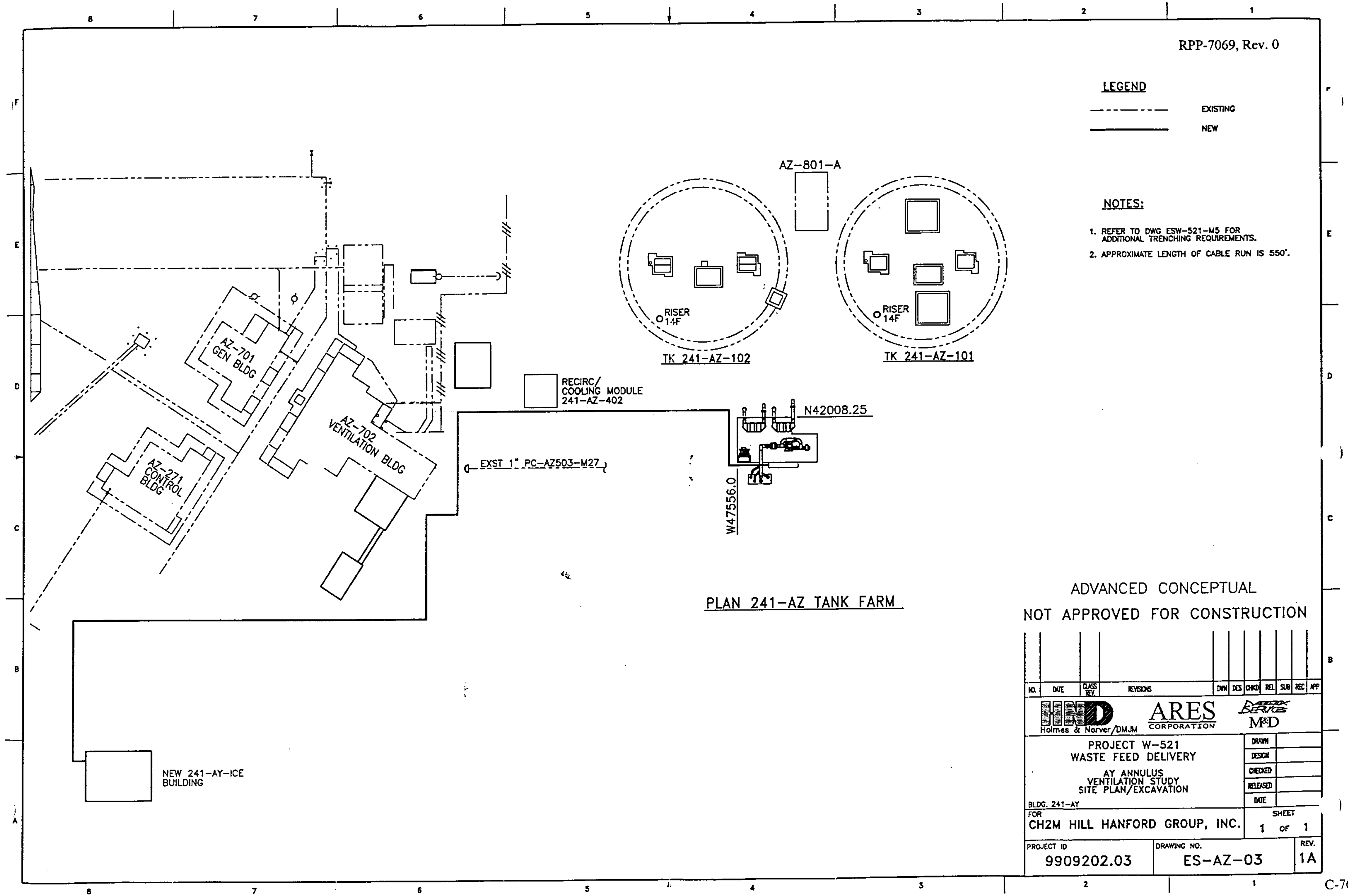
FOR CH2M HILL HANFORD GROUP, INC.

DRAWN / DESIGN / CHECKED / RELEASED / DATE

SHEET 1 OF 2

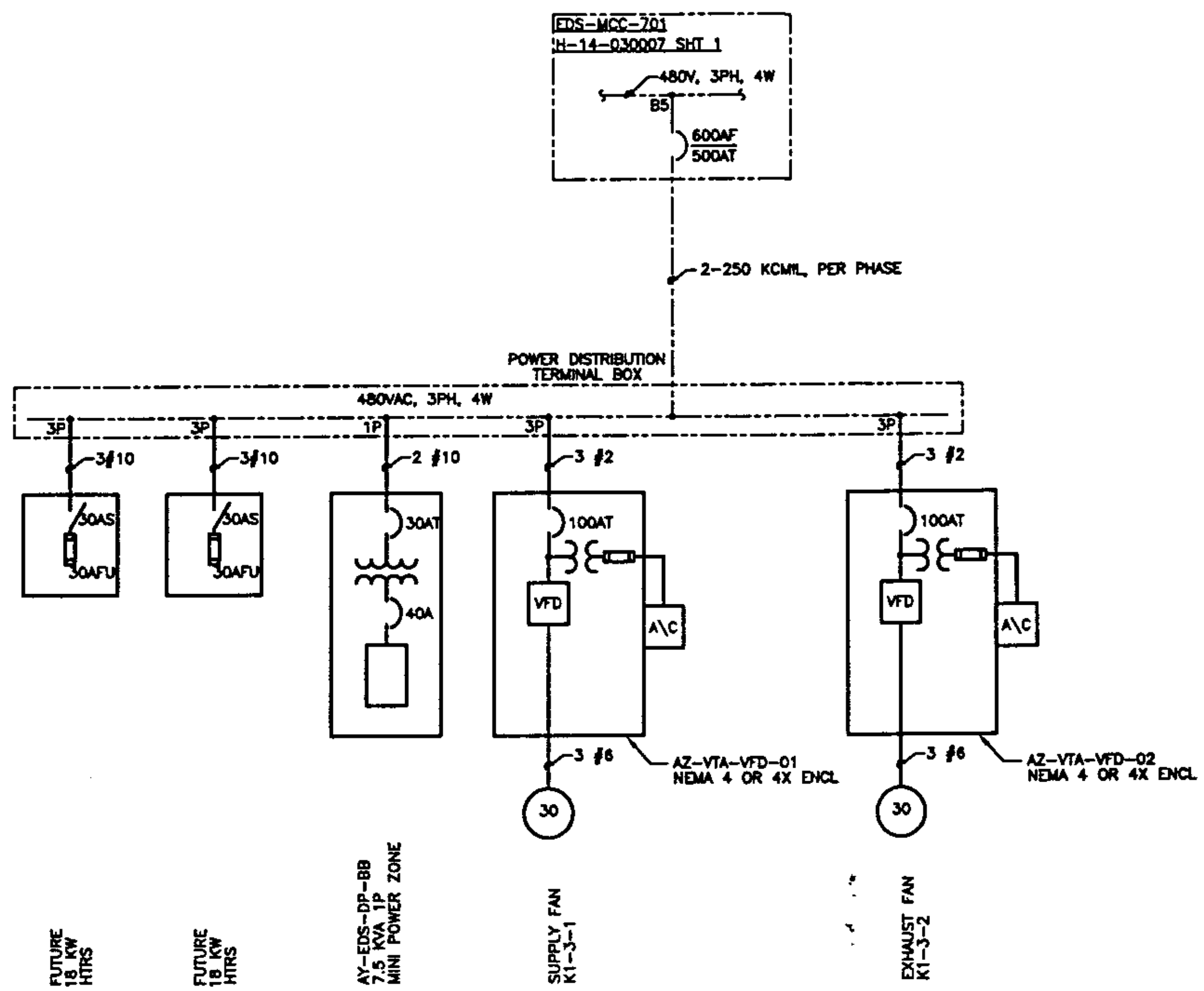
PROJECT ID 9909202.03 — DRAWING NO. ES-AZ-02 — REV. 1A


LEGEND
EXISTING
NEW
16"ø DUCT SCH 10
8"ø DUCT
10"ø DUCT
SECTION (A)
SCALE: NONE
STACK
K1-3-2
SECTION (B)
SCALE: NONE
NEW CAM
NEW CAM
HV-2-2
FV-2-2
HV-2-1
FV-2-1
NEW EXHAUST FILTER
NEW EXHAUST FILTER
16"ø DUCT
STACK
16"ø DUCT SCH 10
INSTRUMENT & CONTROL ENCLOSURE
8"ø DUCT TO TK-101 AIR SLOT
8"ø DUCT TO TK-102 AIR SLOT
10"ø DUCT TO TK-101 ANNULUS
10"ø DUCT TO TK-102 ANNULUS
PLAN - AZ ANNULUS VENTILATION SUPPLY AND EXHAUST
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
VENTILATION
AZ ANNULUS SUPPLY AND EXHAUST
EQUIPMENT LAYOUT
BLDG. 241-AZ
FOR
CH2M HILL HANFORD GROUP, INC.
DRAWN
DESIGN
CHECKED
RELEASED
DATE
SHEET
2 OF 2
PROJECT ID
9909202.03
DRAWING NO.
ES-AZ-02
REV.
1A


LEGEND
EXISTING
NEW
NOTES:
1. REFER TO DWG ESW-521-M5 FOR ADDITIONAL TRENCHING REQUIREMENTS.
2. APPROXIMATE LENGTH OF CABLE RUN IS 550'.
AZ-801-A
RISER 14F
TK 241-AZ-102
RISER 14F
TK 241-AZ-101
RECIRC/ COOLING MODULE 241-AZ-402
N42008.25
W47556.0
EXST 1" PC-AZ503-M27
AZ-701 GEN BLDG
AZ-702 VENTILATION BLDG
AZ-271 CONTROL BLDG
NEW 241-AY-ICE BUILDING
PLAN 241-AZ TANK FARM
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
AY ANNULUS
VENTILATION STUDY
SITE PLAN/EXCAVATION
DRAWN
DESIGN
CHECKED
RELEASED
DATE
BLDG. 241-AY
FOR
CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1
PROJECT ID
9909202.03
DRAWING NO.
ES-AZ-03
REV.
1A

LEGEND

EXISTING (dashed line)
NEW (solid line)



AZ ANNULUS VENTILATION ONE LINE DIAGRAM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP

HND Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-AZ ANNULUS

BLDG. 241-AZ

DRAWN	R.E. WILSON
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

FOR
CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ES-AZ-04	1A

Appendix E
Calculation of
Annulus Pressure of Tank 241-AY-102

Note: The purpose of this calculation is to access the ability to calculate the annulus pressure of the 241-AY and 241-AZ tanks at high flow rates. This calculation is not bounding. Rather the calculation mimics conditions recorded in January of 1998. In that month, field data was collected from the 241-AY-102 annulus ventilation system (Numatec, 1998). With that system operating nominally at 1000 cfm, the annulus pressure was observed to be –15.5-in. (w.g.).

HND Team	CALCULATION COVER SHEET	Calculation No: ME-09

PROJECT TITLE:	CLIENT:
Project W-521 Conceptual Design Report	CH2M Hill Hanford Group

CALCULATION TITLE:

Pressure Drop Calculation of 241-AY-102 Annulus

OBJECTIVE OF THE CALCULATION:

Estimate the pressure drop (in H2O) from flowing 1000 cfm through the annulus vent system of AY-102

APPLICABLE DOCUMENTS:

N/A

Revision	Pages	Revision Description	Prepared by Name/Date	Reviewed by Name/Date	Comments
0	21	Original	A. Hagensen / S. Pierce Scott Pierce 9/21/00	T. Salzano [signature] 9-21-00	N/A

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.:	W-521 ACD	CALC. NO.:	ME-09	REVISION NO.:	Ø	SHEET NO.:	1/21
PREPARED BY:	S. PIERCE / A. HAGENSEN	DATE:	8-18-00	REVIEWED BY:	[signature]	DATE:	9-21-00

PRESSURE DROP ESTIMATE FOR ANNULAR COOLING FLOW IN TANK AY-102

FLOW CONDITION: 1000 CFM AIR ROUTED FROM ATMOS. TO CENTRAL PLENUM UNDERNEATH TANK, DISTRIBUTED THRU COOLING SLOTS & RETURNED TO ANNULUS.

GENERAL DESCRIPTION:

COOLING AIR WILL BE DRAWN THROUGH FOUR 4" SCH 40 PIPE FEEDS. THESE 4" FEEDS CHANNEL FILTERED ATMOS. AIR TO A DISTRIBUTION PLENUM CENTERED UNDERNEATH THE TANK FLOOR. THIS PLENUM SUPPLIES A NETWORK OF COOLING CHANNELS WHICH EXTEND RADIALLY & DISCHARGE INTO THE TANK ANNULUS.

PROBLEM: ESTIMATE THE HEAD LOSS (IN. H_2O) FLOWING 1000 CFM THROUGH AY-102.

REFERENCES:

1. FLUID MECHANICS: AN INTERACTIVE TEXT, JAMES A. LIGGETT & DAVID A. CAUGHEY, VERSION 1.1, 1999, ASCE PRESS.
2. PROJECT W-320 HIGH VACUUM 241-AY-102 ANNULUS VENTILATION SYS OPERATIONAL TEST REPORT. HNF-2317, REV 0.
3. DWG. H-2-64307 STRUCTURAL INSULATING CONCRETE PLAN & DETAILS
4. DWG H-2-77324 SH. 1 REV 2. ANNULUS VENT PIPING TK-102
5. DWG H-2-77325 SH. 1 REV 1. PIPING SECTIONS TK-102
6. INTRODUCTION TO HEAT TRANSFER, FRANK P. INCROPERA & DAVID P. DEWITT. 3rd Ed. JOHN WILEY & SONS. 1996.
7. FLOW OF FLUIDS THROUGH VALVES, FITTINGS, AND PIPE. CRANE CO. TECH PAPER 410 1981

SOLUTION

PER DOCUMENT HNF-2317 REV. 0, ANNULUS VENT SYSTEM TEMPERATURES WILL BE USED. TABLE 1 ON PAGE iv SHOWS MINIMUM, MAXIMUM, AND AVERAGE TEMP. READINGS. THE AVERAGE CASE WILL BE EXAMINED.

	AVERAGE
T_{IN}	41°F
T_{OUT}	59°F
BAR PRESS IN HG	29.0

ARES CORPORATION — **CALCULATION SHEET**

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 2/21

PREPARED BY: ~~A. HAGENSEN~~ S. PIERCE DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

THE VOLUMETRIC FLOWRATE AT THE FAN IS 1000 CFM
THERE ARE 72 OUTER RADIUS SLOTS

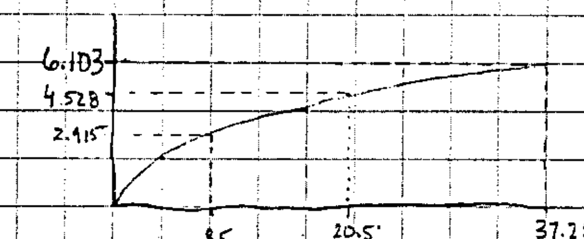
$$Q = \frac{1000\,cfm}{72} = 13.89\,\frac{ft^3}{min}\,\frac{1\,min}{60s}\,\frac{.028317\,m^3}{ft^3} = 65.55\,E\text{-}4\,\frac{m^3}{s}$$

PER REF 5:
AIR IS AT 59°F
$\rho = 1.2167\ \frac{kg}{m^3}$ THEN TOTAL $\dot{m}$, WHICH WILL REMAIN THE SAME THROUGHOUT IS:

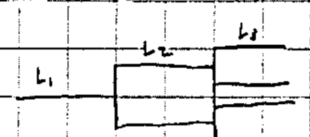
$$1.2167\,\frac{kg}{m^3}\;65.55\,E\text{-}4\,\frac{m^3}{s}\,(72) = .5742\,\frac{kg}{s}$$

THE HEATING OF THE AIR THRU THE SLOTS SHOULD FOLLOW A SIMPLE CURVE, SUCH AS $\sqrt{x}$, SINCE THE WASTE IS THOUGHT TO BE HOTTER IN THE CENTER AND LOSE TEMP. RADIALLY OUTWARD; ALSO BECAUSE THE GREATEST TEMPERATURE GRADIENT WILL BE WHEN THE AIR IS COOLEST. USING THIS MODEL AND THE LENGTHS OF EACH TYPE OF COOLING SLOT, THE PERCENTAGE OF TEMPERATURE GAIN CONTRIBUTED BY EACH SLOT CAN BE CALCULATED.

$L_1 = 8.5' = 2.5908\,m$
$L_2 = 12' = 3.6576\,m$
$L_3 = 16.75' = 5.1054\,m$
37.25



REF # 6



$(100)\frac{2.915}{6.103} = 47.8\%$ OF TEMP RISE IN L_1 $(100)\frac{4.528}{6.103} - 47.8 = 26.4\%$ IN L_2 $100 - 74.2 = 25.8\%$ IN L_3

THE OVERALL TEMP RISE IS

$$59°F - 41°F = 18°F$$

$.478(18) = 8.604°F$ $.264(18) = 4.752°F$ $.258(18) = 4.644°F$

THE AVERAGE TEMP. BETWEEN AIR ENTERING A SLOT AND LEAVING THE SAME SLOT WILL BE USED TO DETERMINE LOSSES IN THE CHANNEL.

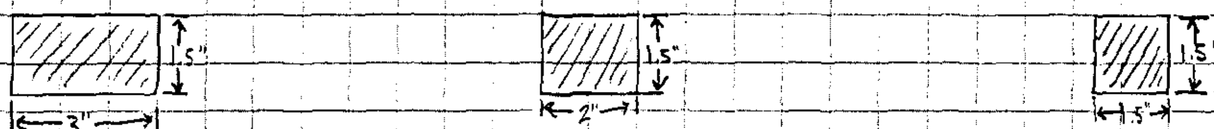
ARES CORPORATION | **CALCULATION SHEET**

PROJECT NO.: W-521 ACD   CALC. NO.: ME-09   REVISION NO.: Ø   SHEET NO.: 3/21

PREPARED BY: A. HAGENSEN / S. PIERCE   DATE: 8-18-00   REVIEWED BY: [signature]   DATE: 9-21-00

COOLING SLOTS   A: AREA, P- PERIMETER, D_H- HYDRAULIC DIAMETER

TYPE 1   REF #6   TYPE 2   TYPE 3



$A_1 = (3)(1.5) = 4.5 \text{ in}^2$ $A_2 = (2")(1.5") = 3 \text{ in}^2$ $A_3 = (1.5")(1.5") = 2.25 \text{ in}^2$

$\boxed{A_1 = 2.903E\text{-}3 \text{ m}^2}$ $\boxed{A_2 = 1.935E\text{-}3 \text{ m}^2}$ $\boxed{A_3 = 1.452E\text{-}3 \text{ m}^2}$

$P_1 = 2(1.5" + 3") = 9 \text{ in}$ $P_2 = 2(2" + 1.5") = 7 \text{ in}$ $P_3 = 2(1.5" + 1.5") = 6 \text{ in}$

$\boxed{P_1 = 2.286E\text{-}1 \text{ m}}$ $\boxed{P_2 = 1.778E\text{-}1 \text{ m}}$ $\boxed{P_3 = 1.524E\text{-}1 \text{ m}}$

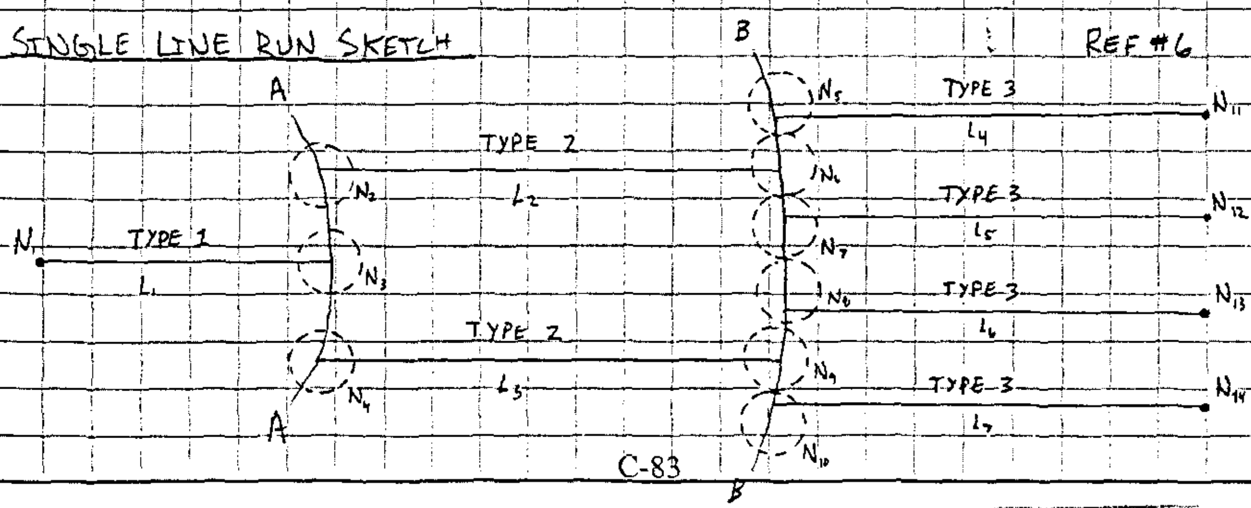
$$D_H = \frac{4A}{P}$$

$$D_{H_1} = \frac{4(2.903E\text{-}3)\text{ m}^2}{(2.286E\text{-}1)\text{ m}} \qquad D_{H_2} = \frac{4(1.935E\text{-}3)\text{ m}^2}{(1.778E\text{-}1)\text{ m}} \qquad D_{H_3} = \frac{4(1.452E\text{-}3)\text{ m}^2}{(1.524E\text{-}1)\text{ m}}$$

$\boxed{D_{H_1} = 5.080E\text{-}2 \text{ m}}$ $\boxed{D_{H_2} = 4.353E\text{-}2 \text{ m}}$ $\boxed{D_{H_3} = 3.811E\text{-}2 \text{ m}}$

ASSUME ALL COOLING SLOTS ARE OPEN AND UNOBSTRUCTED. PER THIS ASSUMPTION AND GIVEN THE SYMMETRY OF THE COOLING SLOT NETWORK (SEE DOC HNF-SD-W320-ER-004, REV. 1, FIG. 2.2), ONE LINE RUN WILL BE EXAMINED AND THE FINDINGS EXTENDED TO THE REMAINING 17 RUNS. (THERE ARE 18 TOTAL RUNS)

SINGLE LINE RUN SKETCH   REF #6



ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 4/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

COOLING SLOTS CONT.

ASSUMPTION: SECTIONS A-A AND B-B ARE DISTRIBUTION CHANNELS THAT CONNECT ALL THE LINE RUNS AROUND THE TANK. THESE ALLOW FOR EVEN DISTRIBUTION OF FLOW FROM EACH TYPE OF SLOT TO THE NEXT. ACTUAL FLOW IN THE DISTRIBUTION CHANNELS WILL BE IGNORED. NODES 1, 11, 12, 13, & 14 WILL BE EXAMINED AS SQUARE ENTRANCE / EXITS, WHILE NODES 2-10 WILL BE EXAMINED AS TEES.

TEMPERATURES IN EACH SLOT:

ASSUME NO HEATING OF THE AIR TAKES PLACE UNTIL IT ENTERS THE FIRST SLOT SECTION.

ENTER L_1 @ 41°F LEAVE L_1 @ $41 + 8.604° = 49.604°F$ AVERAGE $\frac{41 + 49.604}{2}$

$\boxed{= 45.302°F}$

ENTER $L_{2,3}$ @ 49.604° LEAVE @ $49.604 + 4.752 = 54.356°F$ AVERAGE $= \frac{49.604 + 54.356}{2}$

$\boxed{= 52°F}$

ENTER L_{4-7} @ 54.356°F LEAVE @ 59°F AVERAGE: $\frac{54.356 + 59}{2}$

$\boxed{= 56.7°F}$

PROPERTIES OF AIR AT AVERAGE TEMPS REF # 5

45.3°F → $\rho = 1.2522 \frac{kg}{m^3}$ $\nu = 14.16E\text{-}6 \frac{m^2}{s}$ ν = KINEMATIC VISCOSITY

52°F → $\rho = 1.2348 \frac{kg}{m^3}$ $\nu = 14.49E\text{-}6 \frac{m^2}{s}$

56.7°F → $\rho = 1.2227 \frac{kg}{m^3}$ $\nu = 14.72E\text{-}6 \frac{m^2}{s}$

41°F → $\rho = 1.2634 \frac{kg}{m^3}$ $\nu = 13.95E\text{-}6 \frac{m^2}{s}$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 AED CALC. NO.: ME-09 REVISION NO.: 0 SHEET NO.: 5/12

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

FLOW RATES AND FLOW VELOCITIES

TOTAL $\dot{m}$ IS $.5742 \frac{kg}{s}$ (FROM PG 2)

IN L_3 $\frac{.5742}{72} = 7.975E-3 \frac{kg}{s}$ $Q_{L_3} = \frac{7.975E-3 \, kg \, m^3}{1.2227 \, kg \, s} = \boxed{6.522E-3 \frac{m^3}{s}}$

$\dot{m}$ IN L_2 = 2 $\dot{m}$ IN L_{4-7} $2(7.975E-3)\frac{kg}{s} = 1.595E-2 \frac{kg}{s}$

$Q_{L_2} = \frac{1.595E-2 \, kg \, m^3}{1.2348 \, kg \, s} = \boxed{1.292E-2 \frac{m^3}{s}}$

$\dot{m}$ IN $L_1 = 2\dot{m}$ IN $L_{2,3} = \frac{1}{18}\dot{m}_{TOTAL} = \frac{1}{18}.5742 \frac{kg}{s} = 3.19E-2 \frac{kg}{s}$

$Q_{L_1} = \frac{3.19E-2 \, kg \, m^3}{1.2522 \, kg \, s} = \boxed{2.548E-2 \frac{m^3}{s}}$

$\dot{m}$ IN 4" ENTRANCE PIPES = $\frac{1}{4}\dot{m}_{TOTAL} = \frac{.5742}{4}\frac{kg}{s} = .14355 \frac{kg}{s}$

$Q_{4''} = \frac{.14355 \, kg \, m^3}{1.2634 \, kg \, s} = \boxed{11.36E-2 \frac{m^3}{s}}$

LETTING $\bar{V}$ = BULK VELOCITY = Q/A

$\bar{V}_{L_3} = \frac{6.522E-3 \, m^3}{1.452E-3 \, m^2 \, s} = \boxed{4.49 \frac{m}{s}}$ $\bar{V}_{L_2} = \frac{1.292E-2 \, m^3}{1.935E-3 \, m^2 \, s} = \boxed{6.68 \frac{m}{s}}$

$\bar{V}_{L_1} = \frac{2.548E-2 \, m^3}{2.903E-3 \, m^2 \, s} = \boxed{8.78 \frac{m}{s}}$ $\bar{V}_{4''} = \frac{11.36E-2 \, m^3}{\frac{\pi}{4}(.1016)^2 \, m^2 \, s} = \boxed{14.01 \frac{m}{s}}$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 6/21

PREPARED BY: A. HAGENSEN / S. PIERCE DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

RE # DETERMINATION

RE_{D_H} (i.e REYNOLD'S # BASE ON HYDRAULIC DIAMETER) = $\frac{\bar{V} D_H}{\nu}$ REF # 1

$$RE_{DH_{L3}} = \frac{(4.49)\frac{m}{s}(3.811E\text{-}2)m\ s}{(14.72E\text{-}6)m^2} = 11,625$$

$$RE_{DH_2} = \frac{(6.68)\frac{m}{s}(4.353E\text{-}2)m\ s}{(14.49E\text{-}6)m^2} = 20,068$$

$$RE_{DH_1} = \frac{(8.78)\frac{m}{s}(5.080E\text{-}2)m\ s}{(14.16E\text{-}6)m^2} = 31,499$$

$$RE_{D_{4''}} = \frac{(14.01)\frac{m}{s}(.1016)m\ s}{(13.95E\text{-}6)m^2} = 102,037$$

ASSUMPTION: THREE SIDES OF EACH SLOT ARE INSULATING CONCRETE & THE TOP IS STEEL (i.e THE TANK BOTTOM). ASSUME ROUGHNESS IS OF SCALE BETWEEN SMOOTH CONCRETE AND CAST IRON @ ≈ .00028 m PER REF #1. ASSUME 4" INLETS ARE SMOOTH PIPE WITH A ROUGHNESS OF ≈ .000045 m, PER REF #1.

$$K/D_{H_3} = \frac{.00028}{3.811E\text{-}2} = \boxed{7.347E\text{-}3}$$

$$K/D_{H_2} = \frac{.00028}{4.353E\text{-}2} = \boxed{6.432E\text{-}3}$$

$$K/D_{H_1} = \frac{.00028}{5.080E\text{-}2} = \boxed{5.512E\text{-}3}$$

$$K/D_{4''} = \frac{.000045}{(.1016)} = \boxed{4.43E\text{-}4}$$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 A&D CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 7/21

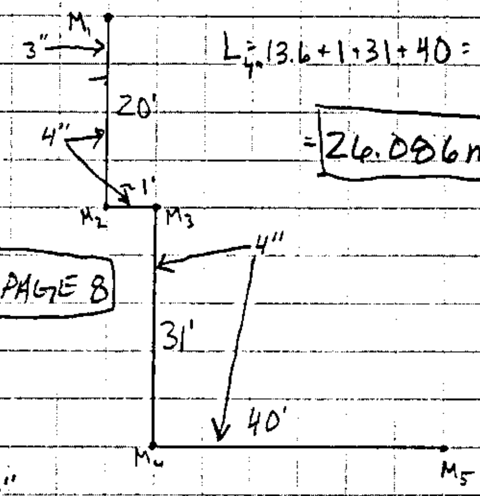
PREPARED BY: S. PIERCE / A. HAGENSEN / [signature] DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

FRICTION FACTORS

FRICTION FACTORS WERE CALCULATED WITH THE USE OF THE COMPUTERIZED MOODY CHART IN REF # 1.

4" INLET LENGTHS

$L_{4"} = 13.6 + 1 + 31 + 40 = 85.6'$ $= \boxed{26.086\,m}$



$f_3 = .03959$

$$\Delta P = f\left(\frac{L}{D_H}\right)\left(\frac{\rho V^2}{2}\right)$$

$f_2 = .0364$

$f_1 = .03389$

FOR 3" PIPE PROPERTIES SEE PAGE 8

$f_{4"} = .02004$

$$\Sigma \Delta P_{2L} = \Delta P_{4"} + \Delta P_{L_1} + \Delta P_{L_2} + \Delta P_{L_3} + \Delta P_{3"}$$

$L_{4"} = 26.086\,m$	$\rho_{4"} = 1.2634$
$L_1 = 2.5908\,m$	$\rho_{L_1} = 1.2522$
$L_2 = 3.6576\,m$	$\rho_{L_2} = 1.2348$
$L_3 = 5.1054\,m$	$\rho_{L_3} = 1.2227$

{kg/m³}

LENGTHS FROM PAGE 2 AND ABOVE DENSITY FROM PAGE 4.

$$\Delta P_{4"} = .02004\left(\frac{26.086}{.1016}\right)\left(\frac{1.2634\,(14.01)^2}{2}\right) = 637.97\,Pa$$

$$\Delta P_{L_1} = .03389\left(\frac{2.5908}{5.080E\text{-}2}\right)\left(\frac{1.2522\,(8.78)^2}{2}\right) = 83.42\,Pa$$

$$\Delta P_{L_2} = .0364\left(\frac{3.6576}{4.353E\text{-}2}\right)\left(\frac{1.2348\,(6.68)^2}{2}\right) = 84.26\,Pa$$

$$\Delta P_{L_3} = .03959\left(\frac{5.1054}{3.811E\text{-}2}\right)\left(\frac{1.2227\,(4.49)^2}{2}\right) = 65.37\,Pa$$

ARES CORPORATION

CALCULATION SHEET

PROJECT No.: W-521 ACD CALC. No.: ME-09 REVISION No.: Ø SHEET No.: 8/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

3" PIPE PROPERTIES

$\dot{m}_{IN} = .5742 \frac{kg}{s}$

$\frac{1}{4}(.5742) = .14355 \frac{kg}{s}$

3" AREA $= \frac{\pi}{4}(3)^2 = 7.069 \, in^2$

$= 4.56 \times 10^{-3} \, m^2$

3" = .0762 m

VELOCITY IN 3"

$\frac{.14355 \, kg \cdot m^3}{1.2634 \, kg \cdot s \cdot 4.56E\text{-}3 \, m^2} = 24.92 \frac{m}{s}$

LENGTHS 7'-9" $\boxed{REF. \#5}$

12'-8" AVG. $= \frac{25.667'}{4}$

3'-6"

1'-9" $\boxed{= 6.417'}$

$\boxed{l = 1.96 \, m}$

RE # $\frac{24.92 \, m \, (.0762) \, m \, s}{s \; 13.95E\text{-}6 \, m^2} = 136,122.15$

$\frac{K}{D} = \frac{.000045}{.0762} = 5.906E\text{-}4$

$f = .01998$ $\boxed{REF \#1}$

LOSSES DUE TO REDUCER 3×4 $\boxed{REF \#7}$

$K = \frac{.8 \sin \frac{\theta}{2} (1 - \beta^2)}{\beta^4}$ $\beta = \frac{D_1}{D_2} = \frac{3}{4} = .75$

$L_e = \frac{KD}{f}$

$= \frac{.8 \sin \frac{30}{2} (1 - .75^2)}{.75^4}$

$= .286$

$L_e = \frac{.286(.0762)}{.01998} = 1.09 \, m$

$\Delta P = .01998 \left(\frac{1.09}{.0762}\right) \left\{\frac{1.2634 \; (24.92)^2}{2}\right\}$

$\Delta P = 112.12 \, Pa = \boxed{.451 \, in \, H_2O}$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 9/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

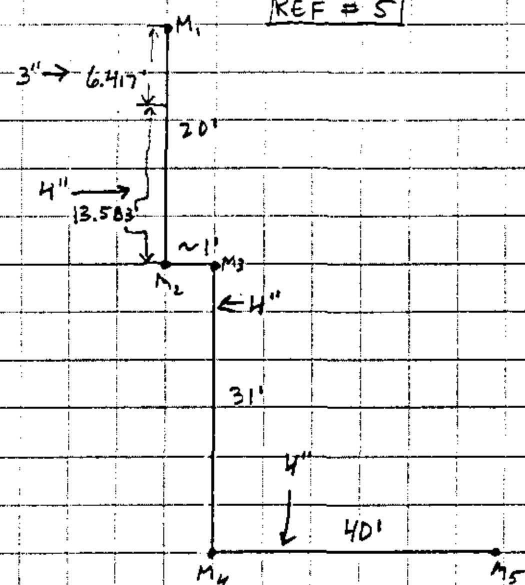
LOSSES DUE TO LENGTH OF 3" PIPE

FOR EACH OF THE 4 FEED LINES DOWN TO THE CENTRAL PLENUM THERE ARE DIFFERENT LENGTHS OF 3" AND 4" PIPE. FOR SIMPLICITY, THE AVERAGE OF THE LENGTHS OF 3" PIPE WILL BE USED, WITH THE REMAINING LENGTH MADE UP OF 4" PIPE.

REF # 5

$$\Delta P_{3''} = .01998\left(\frac{1.96}{.0762}\right)\left(\frac{1.2634}{2}(24.92)^2\right)$$

$$\Delta P_{3''} = 201.61\ Pa$$



SUM OF ALL LOSSES DUE TO LENGTHS

$$\Sigma\Delta P = \Delta P_{4''} + \Delta P_{3''} + \Delta P_{L1} + \Delta P_{L2} + \Delta P_{L3}$$

$$= 637.97 + 201.61 + 83.42 + 84.26 + 65.37$$

$$\boxed{= 1072.63\ Pa}$$

IN EACH RUN, THERE ARE FOUR TYPES OF FITTINGS: 1 SHARP-EDGED INLET
4 - FLOW THRU BRANCH TEES
1 - SHARP EDGED EXIT

THIS IS SEEN ON THE SKETCH ON PAGE 3.

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 10/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

FITTING LOSSES IN TERMS OF EQUIVILENT LENGTHS

$L_e = \frac{KD}{f}$ (SHARP EDGED INLET) $\boxed{\text{REF \#1}}$ FOR ALL K-VALUES

N_1: $K_L = 0.34$ $L_e = \frac{.34(5.080E\text{-}2)\,m}{.03389} = .51\,m$ $\Delta P = .03389\left(\frac{.51}{5.08E\text{-}2}\right)\left(\frac{1.2522}{2}(8.78)^2\right)$

$\boxed{\Delta P = 16.42\ Pa}$

$N_{2,4}$: $K_L = 1.8$ (FLOW THRU BRANCH TEE)

$L_e = \frac{1.8(4.353E\text{-}2)}{.0364} = 2.15\,m$ $\Delta P = .0364\left(\frac{2.15}{4.353E\text{-}2}\right)\left(\frac{1.2348}{2}(6.68)^2\right)$

$\boxed{\Delta P = 49.53\ Pa}$

N_3: $K_L = 1.8$ (FLOW THRU BRANCH TEE)

$L_e = \frac{1.8(5.080E\text{-}2)}{.03389} = 2.698\,m$ $\Delta P = .03389\left(\frac{2.698}{5.08E\text{-}2}\right)\left(\frac{1.2522}{2}(8.78)^2\right)$

$\boxed{\Delta P = 86.87\ Pa}$

$N_{6,9}$: $K_L = 1.8$ (FLOW THRU BRANCH TEE)

$L_e = \frac{1.8(4.353E\text{-}2)}{.0364} = 2.153\,m$ $\Delta P = .0364\left(\frac{2.153}{4.353E\text{-}2}\right)\left(\frac{1.2348}{2}(6.68)^2\right)$

$\boxed{\Delta P = 49.6\ Pa}$

$N_{5,7,8,10}$: $K_L = 1.8$ (FLOW THRU BRANCH TEE)

$L_e = \frac{1.8(3.811E\text{-}2)}{.03959} = 1.73\,m$ $\Delta P = .03959\left(\frac{1.73}{3.811E\text{-}2}\right)\left(\frac{1.2227}{2}(4.49)^2\right)$

$\boxed{\Delta P = 22.15\ Pa}$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 11/21

PREPARED BY: S. PIERCE / H. HAGENSEN DATE: 8-18-00 REVIEWED BY: [signature] DATE: 9-21-00

FITTING LOSSES CONT.

$N_{11,12,13,14}$: $K_L = 1.0$ (SQUARE EDGED EXIT)

$$L_e = \frac{1.0(3.811E\text{-}2)}{.03959} = .963\,m \qquad \Delta P = .03959\left(\frac{.963}{3.811E\text{-}2}\right)\left(\frac{1.2227}{2}(4.49)^2\right)$$

$$\boxed{\Delta P = 12.37\,Pa}$$

SUM OF FITTING LOSSES FOR ONE RUN

$$16.42 + 49.53 + 86.87 + 49.60 + 22.15 + 12.37 = \boxed{236.94\,Pa}$$

M_1: $K_L = 0.34$ (SQUARE EDGED ENTRANCE) $D = .0762\,m$ (3") REF # 7 FOR ALL K-VALUES

$$L_e = \frac{.34(.0762)}{.01998} = 1.30 \qquad \Delta P = .01998\left(\frac{1.30}{.0762}\right)\left(\frac{1.2634}{2}(24.92)^2\right)$$

$$\Delta P = \boxed{133.71\,Pa}$$

$M_{2,3,4}$: $K_L = .9$ (90° ELBOW)

$$L_e = \frac{.9(.1016)}{.02004} = 4.56\,m \qquad \Delta P = .02004\left(\frac{4.56}{.1016}\right)\left(\frac{1.2634}{2}(14.01)^2\right)$$

$$\boxed{\Delta P\ 111.52\,Pa}$$

M_5: $K_L = 1.0$ (SQUARE EDGED EXIT)

$$L_e = \frac{1.0(.1016)}{.02004} = 5.07\,m \qquad \Delta P = .02004\left(\frac{5.07}{.1016}\right)\left(\frac{1.2634}{2}(14.01)^2\right)$$

$$\Delta P = \boxed{124.0\ Pa}$$

SUM OF FITTING LOSSES FOR ONE FEED

$$133.71 + 112.12 + 3(111.52) + 124.0 = \boxed{704.39\,Pa}$$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-02 REVISION NO.: 0 SHEET NO.: 12/21
PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-18-00 REVIEWED BY: DATE: 9-21-00

TOTAL LOSSES FOR ANNULUS VENT SYSTEM

1072.63 + 236.94 + 704.39 = 2013.96 Pa

2013.96 Pa = $\boxed{8.09 \text{ in } H_2O}$

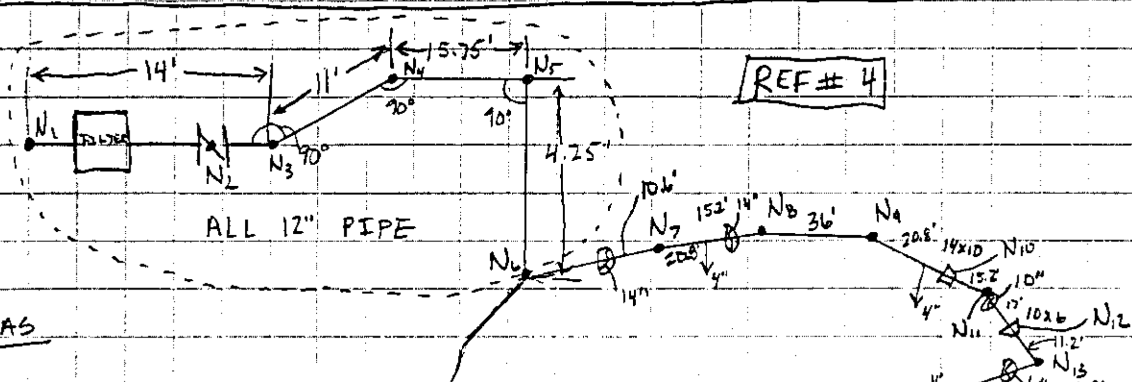
ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 13/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-23-00 REVIEWED BY: [signature] DATE: 9-21-00

ANNULUS VENTILATION INLET LOSSES FOR AY-102



AREAS

$\dot{m}$ IN IS STILL A CONSTANT $0.5742 \frac{kg}{s}$ + ρ @ 41°F = $1.2634 \frac{kg}{m^3}$ $\nu = 13.95E\text{-}6 \frac{m^2}{s}$

AREA OF 12" PIPE = $\frac{\pi}{4}(12)^2 = 113.1 \text{ in}^2 = \boxed{.0730 \text{ m}^2}$

14" PIPE = $\frac{\pi}{4}(14)^2 = 153.94 \text{ in}^2 = \boxed{.0993 \text{ m}^2}$

10" PIPE = $\frac{\pi}{4}(10)^2 = 78.54 \text{ in}^2 = \boxed{.0507 \text{ m}^2}$

6" PIPE = $\frac{\pi}{4}(6)^2 = 28.27 \text{ in}^2 = \boxed{.0182 \text{ m}^2}$

VELOCITIES

$V = \frac{\dot{m}}{\rho A}$ $V_{12''} = \frac{.5742 \text{ kg} \quad m^3}{1.2634 \text{ kg} \quad s \,(.0730) m^2} = 6.23 \frac{m}{s}$

AFTER THE 12" PIPE THERE IS A TEE LEADING INTO THE 14" PIPE. FOLLOWING THE TEE ONE WAY LEADS TO ONE OF THE 3-4" DROPS INTO THE ANNULUS, AND THE OTHER SIDE OF THE TEE LEADS TO THE OTHER THREE. STICKING TO THE ORIGINAL ASSUMPTION THAT THE MASS FLOW IS EQUAL IN ALL FOUR 3-4" INLET PIPES, 3/4 OF $\dot{m}$ WILL GO TO THE SIDE WITH THREE 3-4" DROPS. ALSO IN ORDER TO APPROXIMATE THE LOSSES IN THE LINES DIRECTLY AFTER THE TEE AND LEADING TO EACH 3-4" DROP, THE LONGEST DISTANCE LOSSES AND THE SHORTEST DISTANCE LOSSES WILL BE AVERAGED. THIS AVERAGE WILL BE APPLIED AS IF THEY WERE ALL EQUAL TO IT. (AFTER EACH 3-4" DROP THE REMAINING $\dot{M}$ WILL BE DECREASED BY $\frac{1}{4}$.

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: 0 SHEET NO.: 14/21

PREPARED BY: J. PIERCE / A. HAGENSEN DATE: 8-23-00 REVIEWED BY: [signature] DATE: 9-21-00

VELOCITIES (CONT)

TO FIRST 4" DROP (CLOSEST)

$\dot{m} = .75(.5742)\frac{kg}{s} = .43065\ \frac{kg}{s}$ $V = \frac{Q}{A} = \frac{\dot{m}}{\rho A}$

$V_{14-1} = \frac{.43065}{(1.2634)(.0993)} = 3.43\ \frac{m}{s}$

TO SECOND 4" DROP

$\dot{m} = .5(.5742) = .2871\ \frac{kg}{s}$ $V_{10"} = \frac{.14355}{(1.2634)(.0507)} = 2.24\ \frac{m}{s}$

$V_{14-2} = \frac{.2871}{(1.2634)(.0993)} = 2.29\ \frac{m}{s}$

TO THIRD 4" DROP (FARTHEST)

$\dot{m} = .25(.5742) = .14355\ \frac{kg}{s}$

$V_{6-3} = \frac{.14355}{(1.2634)(.0182)} = 6.25\ \frac{m}{s}$

DETERMINATION OF RE # $RE = \frac{VD_H}{\nu}$

$RE_{14-1} = \frac{(3.43)(.3556)}{13.95E-6} = 87434.3$ $RE_{12"} = \frac{6.23(.3048)}{13.95E-6} = 136,122.2$

$RE_{14-2} = \frac{(2.29)(.3556)}{13.95E-6} = 58,374.5$

$Re_{10"-3} = \frac{2.24(.254)}{13.95E-6} = 40,785.7$

$Re_{6-3} = \frac{6.25(.1524)}{13.95E-6} = 68279.6$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 15/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-23-00 REVIEWED BY: [signature] DATE: 9-21-00

FRICTION FACTORS

ASSUME ALL PIPE HAS A ROUGHNESS OF .000045 m

$$\frac{K}{D_{14''}} = \frac{.000045}{.3556} = \boxed{1.265\text{ E-}4}$$

$$\frac{K}{D_{10''}} = \frac{.000045}{.254} = \boxed{1.772\text{ E-}4}$$

$$\frac{K}{D_{6''}} = \frac{.000045}{.1524} = \boxed{2.953\text{E-}4}$$

$$\frac{K}{D_{12''}} = \frac{.000045}{.3048} = \boxed{1.476\text{ E-}4}$$

FRICTION FACTORS TAKEN FROM COMPUTERIZED MOODY CHART IN REF. #1

$f_{12''} = .01779$

$f_{14\text{-}1} = .01911$

$$\Delta P = f\left(\frac{L}{D}\right)\left\{\frac{\rho V^2}{2}\right\}$$

$f_{14\text{-}2} = .02068$

$f_{10''\text{-}3} = .02243$

$f_{6\text{-}3} = .02071$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-02 REVISION NO.: Ø SHEET NO.: 16/21

PREPARED BY: J. PIERCE A. HAGENSEN DATE: 8-23-00 REVIEWED BY: DATE: 9-21-00

$L_{12"} = 45' = 13.716\ m$ REF # 4

$L_{14-1} = 31.39' = 9.57\ m$

$L_{14-2} = 72' = 21.95\ m$

$L_{10-3} = 32' = 9.75\ m$

$L_{6-3} = 38.0' = 11.59\ m$

PRESSURE DROP DUE TO LENGTH IN THE 12" PIPE

$$\Delta P_{12} = .01778 \left(\frac{13.716}{.3048}\right)\left\{\frac{1.2634}{2}(6.23)^2\right\} = \boxed{19.63\ Pa}$$

PRESSURE DROP FOR THE SHORTEST DISTANCE DUE TO LENGTH

$$\Delta P_{14-1} = .01911 \left(\frac{9.57}{.3556}\right)\left\{\frac{1.2634}{2}(3.43)^2\right\} = \boxed{3.82\ Pa}$$

PRESSURE DROP FOR THE LONGEST DISTANCE DUE TO LENGTHS

$$\Delta P = \Delta P_{14-1} + \Delta P_{14-2} + \Delta P_{10-3} + \Delta P_{6-3}$$

$$\Delta P_{14-2} = .02068 \left(\frac{21.95}{.3556}\right)\left\{\frac{1.2634}{2}(2.29)^2\right\} = 4.23\ Pa$$

$$\Delta P_{10-3} = .02243 \left(\frac{9.75}{.254}\right)\left\{\frac{1.2634}{2}(2.24)^2\right\} = 2.73\ Pa$$

$$\Delta P_{6-3} = .02071 \left(\frac{11.59}{.1524}\right)\left\{\frac{1.2634}{2}(6.25)\right\} = 38.86\ Pa$$

$$\Delta P = 3.82 + 4.23 + 2.73 + 38.86 = \boxed{49.64\ Pa}$$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: 0 SHEET NO.: 17/21

PREPARED BY: A. HAGENSEN / S. PIERCE DATE: 8-23-00 REVIEWED BY: [signature] DATE: 9-21-00

LOSSES IN FITTINGS

$L_e = \frac{KD}{f}$ $\boxed{\text{REF \#1}}$

N_1: $D = .3048$ $f = .01779$ $K \approx .34$ (SQUARE EDGED ENTRANCE)

$L_e = \frac{.34(.3048)}{.01779} = 5.83\text{ m}$ $\Delta P = .01779\left(\frac{5.83}{.3048}\right)\left\{\frac{1.2634}{2}(6.23)^2\right\} = ($

$\Delta P = \boxed{8.34\text{ Pa}}$

N_2: $D = .3048$ $f = .01779$ $K \approx 35f$ (12" BUTTERFLY VALVE) $\boxed{\text{REF \#7}}$

$= 35(.01779) = .62265$

$L_e = \frac{.62265(.3048)}{.01779} = 10.67\text{ m}$

$\Delta P = .01779\left(\frac{10.67}{.3048}\right)\left\{\frac{1.2634}{2}(6.23)^2\right\} = 15.27\text{ Pa}$

$N_{3,4,5}$: $D = .3048$ $f = .01779$ $K \approx 14f$ (90° ELBOWS) $r/d \approx 1.5$ $\boxed{\text{REF \#7}}$

$\approx 14(.01779) = .24906$

$L_e = \frac{.24906(.3048)}{.01779} = 4.267\text{ m}$

$\Delta P = .01779\left(\frac{4.267}{.3048}\right)\left\{\frac{1.2634}{2}(6.23)^2\right\}$

$\Delta P = 6.106\text{ Pa}$ (3 times) $= \boxed{18.32\text{ Pa}}$

N_6: $D = .3048$ $f = .01779$ $K = 60f$ (TEE - FLOW THRU BRANCH) $\boxed{\text{REF \#7}}$

$= 60(.01779) = 1.0674$

$L_e = \frac{1.0674(.3048)}{.01779} = 18.288$

$\Delta P = .01779\left(\frac{18.288}{.3048}\right)\left\{\frac{1.2634}{2}(6.23)^2\right\}$

$\Delta P = 26.17\text{ Pa}$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: MF-09 REVISION NO.: 0 SHEET NO.: 13/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-23-00 REVIEWED BY: [signature] DATE: 9-21-00

LOSSES IN FITTINGS (CONT)

N_7: $D = .3556$ $f = .01911$ $K \approx 16f$ (45° ELBOW)

$= 16(.01911) = .30576$

$L_e = \frac{.30576(.3556)}{.01911} = 5.69\,m$

$$\Delta P = .01911\left(\frac{5.69}{.3556}\right)\left\{\frac{1.2634}{2}(3.43)^2\right\}$$

$\Delta P = \boxed{2.27\ Pa}$

$N_{8,9}$: $D = .3556\,m$ $f = .02068$ $K \approx 16f$ (45° ELBOW)

$\approx 16(.02068) = .33088$

$L_e = \frac{.33088(.3556)}{.02068} = 5.69\,m$

$$\Delta P = .02068\left(\frac{5.69}{.3556}\right)\left\{\frac{1.2634}{2}(2.29)^2\right\}$$

$\Delta P = 1.10\ Pa$ (2 times) $= \boxed{2.20\ Pa}$

N_{10}: $D_1 = 14\,in$ $D_2 = 10\,in = .254\,m$ $\theta \approx 30°$ $K = \frac{.8 \sin\frac{\theta}{2}(1-\beta^2)}{\beta^4}$ $\beta = \frac{D_2}{D_1}$ (GRADUAL CONTRACTION)

$f = .02243$

$K = \frac{.8 \sin 15\left(1-\left(\frac{10}{14}\right)^2\right)}{\left(\frac{10}{14}\right)^4} = .39$

$L_e = \frac{.39(.254)}{.02243} = 4.42\,m$

$$\Delta P = .02243\left(\frac{4.42}{.254}\right)\left\{\frac{1.2634}{2}(2.24)^2\right\}$$

$\Delta P = \boxed{1.24\ Pa}$

N_{11}: $D = .254$ $f = .02243$ $K = 16f$ (45° ELBOW)

$16(.02243) = .35888$

$L_e = \frac{.35888(.254)}{.02243} = 4.064\,m$

$$\Delta P = .02243\left(\frac{4.064}{.254}\right)\left\{\frac{1.2634}{2}(2.24)^2\right\}$$

$\Delta P = \boxed{1.14\ Pa}$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: Ø SHEET NO.: 19/21

PREPARED BY: S. PIERCE / A. HAGENSEN DATE: 8-23-00 REVIEWED BY: [signature] DATE: 9-21-00

LOSSES IN FITTINGS (CONT)

N_{12}: $D_1 = 10\,in$ $D_2 = 6\,in$ $\theta = 30°$ $K = \frac{.8 \sin\frac{\theta}{2}(1-\beta^2)}{\beta^4}$ $\beta = \frac{D_2}{D_1}$ (GRADUAL CONTRACTION)

$L_e = \frac{1.02(.1524)}{.02071} = 7.52\,m$

$K = \frac{.8 \sin 15 (1-(\frac{6}{10})^2)}{(\frac{6}{10})^4} = 1.02$

$\Delta P = .02071\left(\frac{7.52}{.1524}\right)\left\{\frac{1.2634}{2}(6.25)^2\right\}$

$\Delta P = \boxed{25.22\ Pa}$

N_{13}: $D = .1524\,m$ $f = .02071$ $K = 16f$ (45° ELBOW)

$= 16(.02071)$

$= .33136$

$L_e = \frac{.33136(.1524)}{.02071} = 2.4384\,m$

$\Delta P = .02071\left(\frac{2.4384}{.1524}\right)\left\{\frac{1.2634}{2}(6.25)^2\right\}$

$\Delta P = \boxed{8.18\ Pa}$

PRE-FILTER AND HEPA FILTER: TEST DATA INCLUDED IN DOCUMENT HNF-2317 SHOWED THE PRESSURE DROP ACROSS EACH FILTER TO BE .03 in H_2O. THE TOTAL IS THEN 0.06 in H_2O.

0.06 in H_2O = 14.93 Pa

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-02 REVISION NO.: 0 SHEET NO.: 20/21

PREPARED BY: S. PIERCE/ A. HAGENSEN DATE: 8-23-00 REVIEWED BY: DATE: 9-21-00

PRESSURE DROP FOR THE 12" PIPE INCLUDING ALL ELEMENTS & FITTINGS

$$\Delta P_{12} = \Delta P_L + \Delta P_{N_1} + \Delta P_{PRE\text{-}FILTER} + \Delta P_{HEPA} + \Delta P_{N_2} + \Delta P_{N3,4,5} + \Delta P_{N_6}$$

$$= 19.63 + 8.34 + 7.465 + 7.465 + 15.27 + 18.32 + 26.17$$

$$= \boxed{102.66\ Pa}$$

PRESSURE DROP IN THE SHORT DISTANCE INCLUDING ALL FITTINGS

$$\Delta P_{SHORT} = \Delta P_L + \Delta P_{N_7}$$

$$= 3.82 + 2.27$$

$$= \boxed{6.09\ Pa}$$

PRESSURE DROP IN THE LONGEST DISTANCE INCLUDING ALL FITTINGS

$$\Delta P_{LONG} = \Delta P_L + \Delta P_{N_7} + \Delta P_{N_{8,9}} + \Delta P_{N_{10}} + \Delta P_{N_{11}} + \Delta P_{N_{12}} + \Delta P_{N_{13}}$$

$$= 49.64 + 2.27 + 2.20 + 1.24 + 1.14 + 25.22 + 8.18$$

$$= \boxed{89.89\ Pa}$$

AVERAGE OF LONG DISTANCE PRESSURE DROP AND SHORT DISTANCE.

$$\frac{6.09 + 89.89}{2} = 48\ Pa$$

INLET PRESSURE DROP

$$\Delta P_I = \Delta P_{12"} + \Delta P_{AVE}$$

$$= 102.66 + 48 = 150.66\ Pa = .61\ in\ H_2O$$

TOTAL PRESSURE DROP FOR AY-102 ANNULUS VENT SYSTEM

$$= 0.61 + 8.09 = \boxed{8.70\ in\ H_2O}$$

ARES CORPORATION

CALCULATION SHEET

PROJECT NO.: W-521 ACD CALC. NO.: ME-09 REVISION NO.: 0 SHEET NO.: 21/21

PREPARED BY: S. PIERCE A. HAGENSEN DATE: 9-21-00 REVIEWED BY: DATE: 9-21-00

CONCLUSION:

AT A FLOW RATE OF 1000 CFM, THE CALCULATED ANNULUS PRESSURE IS -8.70 IN WATER. THIS VARIES CONSIDERABLY FROM FIELD DATA COLLECTED IN JAN. OF 1998 (HNF-2317 REV 0) THEY FOUND A FLOWRATE OF 984 CFM RESULTED IN A PRESSURE OF ≈ -14.5 IN H_2O THE DIFFERENCE IS MOST LIKELY EXPLAINED BY THE CONDITION OF THE FLOW PASSAGES. IT WAS ASSUMED THAT THEY WERE UNBLOCKED AND IN PERFECT SHAPE, WHILE IN ACTUALITY THEY MAY BE SOMEWHAT BLOCKED AND/OR DETERIORATING.

Attachment D

Attachment D

Refine 241-AZ-151 Decommissioning

REFINE 241-AZ-151 DECOMMISSIONING

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Release 46
Report No. 990920203-022
ACDR Subtask 4
Revision 0

September 2000

prepared by

HND TEAM

REFINE 241-AZ-151 DECOMMISSIONING

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Release 46
Report No. 990920203-022
ACDR Subtask 4
Revision 0

Prepared by: Nathan R. Roe

Approved by: R L Fritz
Robert L. Fritz

Date: 9-29-00

Table of Contents

Appendices

Figures

Tables

Acronyms

ACD	Advanced Conceptual Design
ALARA	As Low As Reasonably Achievable
CHG	CH2M Hill Hanford Group, Inc.
DOE	U.S. Department of Energy
DST	Double-Shell Tank
FIC	Food Instrument Corporation
IMUST	Inactive Miscellaneous Underground Storage Tank
PC	Privatization Contractor
ROM	Rough Order of Magnitude
RPP	River Protection Project
SST	Systems, Structures, and Components
TMACS	Tank Monitoring and Control System
TWRS	Tank Waste Remediation System
WFD	Waste Feed Delivery
WTF	Waste Treatment Facility

1.0 INTRODUCTION

Several small tanks associated with the Hanford Site Tank Farms, generally called "catch tanks", were identified in 1996 as being in need of an assessment to determine whether they were in compliance with specific State and Federal regulations, and to identify what alternatives are available to manage these tanks in a manner which is acceptable to the Washington State Department of Ecology (Ecology) and the U.S. Department of Energy (DOE). Subsequently, a *Catch Tank Code Compliance Evaluation and Alternatives Study* (HNF-SD-TWR-ES-005, Rev. 0) was commissioned in early 1997 to evaluate the potential path-forward with respect to 200 Area tanks (catch tanks).

The catch tanks have capacities ranging from a few hundred gallons to a maximum of fifty thousand gallons. They are used primarily to provide secondary containment for transfer lines, seal loops, and valve or diversion boxes. The 241-AZ-151 Catch Tank was included in the study referenced above and determined to be a tank with long-term need. Therefore, the recommendation resulting from the evaluation and alternative study was to upgrade the system by completely replacing the catch tank with a tank that provides proper secondary containment. Later, the tank function was changed from a secondary containment capacity to a condensate catch location. Furthermore, project goals and 200 Area Tank Farm configurations have changed, which resulted in a W-521 Project recommendation to remove the tank from service and begin closure procedures to transfer the tank to the Inactive Miscellaneous Underground Storage Tank (IMUST) list. This recommendation was based on the evaluation of the tank from a perspective including regulatory goals, reduced risk, and life-cycle costs. The W-521 recommendation was also based on past negotiations with Ecology that decided, for catch tanks, once stabilized and placed on the IMUST list, monitoring would no longer be required. Although the recommendation was accurate at the time, missed project milestones and the recent issuance of State of Washington Department of Ecology Administrative Order No. 00NWPKW-1251, have resulted in changes to the methodology employed by Ecology. The classification IMUST and the corresponding list has not been implemented to date and will not be in the future. Instead, Ecology has ordered (as of June 13, 2000) the DOE and CH2M Hill Hanford Group, Inc. (CHG) to submit a written report (tabular listing) describing the disposition of all double shell tank (DST) transfer system components, including 241-AZ-151, on or before December 16, 2000. The listing must describe when each component will be officially removed from service and a description of the disposition, for approval by Ecology.

1.1 Purpose

The purpose of this task was to review and refine the approach to be used for the 241-AZ-151 decommissioning to determine an effective strategy with respect to regulatory compliance, time to complete the task, cost to complete the task, and the logistics associated with decommissioning the tank.

1.2 Scope

The overall W-521 Advanced Conceptual Design (ACD) objective was to refine the initial project technical and cost baselines, consistent with the latest information. Decommissioning the 241-AZ-151 Tank was initially reviewed as part of the W-521 conceptual design and a base strategy of capping and leaving in place was developed. The scope of this analysis was limited to assessing 241-AZ-151 as it pertains to transitioning the catch tank from an operating tank to a DST transfer system component designated for initial decommissioning (i.e., designated as a tank that will not remain in use beyond June 30, 2005, and therefore included on the tabular list required by Ecology).

1.2.1 Site Description

The 241-AZ-151 Catch Tank is located within the AZ Farm, west of the 241-AZ-152 sluice transfer box, in the 200 East Area. Throughout the life of the tank, it has received drainage from the 241-AZ-101 and –102 vent header seal loops, AZ Tank farm Leak detection pits, 241-AZ-801A instrumentation building floor drain, process condensate from the 241-AZ-702 Ventilation Building, and 241-AZ-152 sluicing transfer box floor drain. See Table 1-1 for all lines, including electrical, currently identified as leading to the tank. Appendix A provides detailed status information on these lines.

The 27-year-old tank is a concrete vault lined with 10 gauge carbon steel. Being incased in concrete, the carbon steel liner does not require cathodic protection so no deterioration is expected due to galvanic action. The tank contents are not routinely treated to inhibit general internal corrosion; however, a report assessing the need to add corrosion inhibitors concluded that no chemical adjustments were recommended due to the fact that the tank is pumped out at regular interval (Palit 1996). The catch tank concrete vault is L-shaped, consisting of a pump pit on the upper section and a reservoir in the lower section (see attached Drawing H-2-68316, Appendix B). The pump pit inside dimensions are 6 ft long by 6 ft wide by 10 ft 11 in. deep. The reservoir area is 24 ft long by 6 ft wide by 11 ft deep. The concrete wall is 12 in. thick all around. The pump pit has a cover block on top. The inside surface of the lower section is lined with 10 gauge carbon steel. The reservoir floor slopes towards a sump location at one end.

The catch tank has a maximum holding capacity of 11,900 gallons, but is controlled administratively to a volume of 9520 gallons (Ryan 1994). The total annual accumulation consisting of process drain and rain intrusion is estimated to be approximately 60,000 gallons, of which 600 gallons can be attributed to rain intrusion. The 241-AZ-151 Transfer Pump intake extends down into the sump but the catch tank is capable of being pumped below floor level.

The chemical injection access into the catch tank can be made by opening the monitor plug on the cover block (see attached Drawing H-2-68316, Appendix B). Additionally, the injection drains can be accessed through the pump pit, into the catch tank, located below the pit.

Table 1-1. 241-AZ-151 Tank Lines.

Line ID	In From	Out To	Elev. At Tank
2"-DR-0085-M5	241-AZ-155 Storage Pit	NA	659.84 BOP
2"-PW-4602-M5 (4603/4602 & 4604/4602)	AZ-Leak Detection Pit	NA	659.84 BOP
2"-DR-0081-M5	Drains From Abandoned AZ Ventilation Headers	NA	659.84 BOP
3"-DR-0086-M5	Floor Drain & Compressor Condensate Drain From 241-AZ-801A, 241-AZ-702 Ventiliation Bldg.	NA	659.84 BOP
3"-PW-4605-M5	NA	241-AZ-152 Sluicing Transfer Box	670.50 CL
4"-DR-0084	241-AZ-152 Sluicing Transfer Box Drain	NA	659.84 BOP
2"-V-0608-M5	NA	241-AZ-702 Ventilation Bldg.	666.33 CL
½"-151-IA (HI)-M9	NA	241-AZ-157 Instrument Enclosure	672.00
½"-151-IB (LO)-M9	NA	241-AZ-157 Instrument Enclosure	672.00
½"-151-IC (MED)-M9	NA	241-AZ-157 Instrument Enclosure	672.00
1½"-RW-3603-M5	1½"-RW-3636-M5	NA	672.17 CL
1"-RW-36020M5	1½"-RW-3636-M5	NA	666.81 CL
1"-PC-AZ503-M27	241-AZ-702 Ventilation Bldg.	NA	662.75 BOP
ELECTRICAL			
ED-MCC-704 PANELBOARD B	241-AZ-801A P-AZ-801A	NA	NA
ED5-MCC-704 BREAKER C1	241-AZ-801A	NA	NA

2.0 METHODOLOGY

The methodology employed for this task was to: 1) identify the applicable regulations with regards to performing initial decommissioning for the tank; 2) identify viable 241-AZ-151 options consistent with other site decommissioning activities; 3) compare (using the guidance for an Alternative Generation Analysis, contained in HNF-IP-0842, Section 3.3, *Alternative Generation and Analysis*) the various options of accomplishing the decommissioning; and 4) document the results of the comparison (preferred method) for decommissioning the 241-AZ-151 Tank.

The need for the tank decommissioning was documented and defined in Section 4.0 problem definition. To accomplish the decommissioning, a list of viable alternatives was created and discussed in Section

5.0. Section 6.0 then ranked each alternative/component with respect to: 1) effectiveness, 2) initial cost, and 3) life-cycle cost. Recommendations were formulated based on this information.

2.1 Regulatory Methodology

At present, DOE facilities designated for deactivation are subject to guidelines defined under DOE/EM-0246, *Decommissioning Resource Manual.* The resource manual provides necessary reference for the DOE decommissioning program conducted by the Office of Environmental Restoration (EM-40). In preparation for the final transition to EM-40, the deactivation activities under guidance of DOE/EM-0246 are designed to place the facility in a safe and stable condition to minimize the long-term cost of surveillance and maintenance programs that are protective of workers, public, and the environment, until final decommissioning is completed.

On June 13, 2000, Ecology reiterated the guidance from the *Decommissioning Resource Manual* as well as mandated action towards decommissioning the catch tanks with the issuance of State of Washington Department of Ecology Administrative Order No. 00NWPKW-1251. Contained in the Administrative Order were specific actions required to finalize initial decommissioning and prepare the catch tanks for final transition to EM-40. The actions identified in the Ecology Order also comply with the intent set forth in the DOE guidance with respect to performing initial decommissioning resulting in a safe and stable facility configuration, ready for final decommissioning by EM-40.

The actions identified in the Ecology Administrative Order were as follows: 1) stabilization of the tank; 2) isolation of the tank; and 3) monitoring the tank. Completion of these steps would conclude initial decommissioning. Therefore, the methodology described above was based on ranking the alternatives correlating to each specific action outlined for successful initial decommissioning. Each action of the initial decommissioning (stabilize, isolate, and monitor) had a number of alternatives, described in Section 5.0 that were identified and evaluated independently. The alternative that scored the best for each action (i.e., each component of decommissioning) was chosen and combined with the best alternatives for the other actions to form the preferred alternative.

3.0 ASSUMPTIONS/UNCERTAINTY

The present physical condition of the catch tank caused some uncertainty inherent in the evaluation, conclusion, and recommendation of this report. The advanced age and exposure to elements, both inside and outside the tank, were considered factors of uncertainty involved in decommissioning the tank. The following assumption regarding this uncertainty was made:

- The physical condition, including structural integrity, of the catch tank would not prohibit implementation of viable decommissioning alternatives.

The present penetrations to the 241-AZ-151 Tank include lines from numerous facilities that were identified throughout this document and in Table 1-1. The current scope of Project W-521 already includes the rerouting of a process condensate line (PC-AZ503-M27) as part of another effort, independent of the tank decommissioning. Therefore, PC-AZ503-M27 was not included in the scope of activities concerning initial decommissioning. The source and potential rerouting of all other lines was not examined for the purposes of this study, per direction transmitted from the CHG during a Value Engineering meeting held August 22, 2000. Although the following assumptions were prescribed by CHG, it was not clear that the data supporting the assumptions was confirmed. Subsequently, Appendix A documents those lines that were confirmed as being out-of-service and those that could require additional investigation. The following assumptions regarding these issues were made:

- All lines entering the 241-AZ-151 Tank, recognizing PC-AZ503-M27 would have already been rerouted, would be out-of-service.

- Cost and logistics concerned with completing initial decommissioning would be based on cutting and capping all lines, recognizing PC-AZ503-M27 would have already been rerouted, entering the pit/tank.

In preparation for the final transition to EM-40, the deactivation activities under guidance of DOE/EM-0246 were designed to place the facility in a safe and stable condition to minimize the long-term cost of a surveillance and maintenance program that would be protective of workers, public, and the environment until final decommissioning was completed. As identified previously in this study, Ecology had mandated specific activities to be accomplished to prepare the tank for final decommissioning (stabilization, isolation and monitoring). Additionally, a description of the final disposition of each component upon removal from service (i.e., inclusion within a RCRA Closure Plan) was required. The following assumption regarding this activity was made:

- CHG would prepare and deliver the description of final disposition, consistent with other documents prepared for Ecology with respect to RCRA Closure Plans. This document would obviously serve as a major component of the basis for the final disposition description.

4.0 PROBLEM DEFINITION

The preparation of the W-521 Conceptual and ACDs and other current Tank Farm activities raised issues associated with the approach to decommission the 241-AZ-151 catch tank. As the Tank Farms transitioned to processing waste through Phase 1 WFD to the Waste Treatment Facility (WTF) and respective projects near the definitive phase, the need to complete the initial decommissioning of the tank in a timely and cost effective manner was clear. The characteristics of the pit that were deficient with respect to acceptable initial tank decommissioning criteria were identified in the following two sections. The third section (Section 4.3, Monitoring of Tank 241-AZ-151) did not identify a problem with the current monitoring system, it simply identified the existing configuration. No problem exists with the use of the ENRAF system as a means of monitoring an initially decommissioned tank.

4.1 Stabilization Of Tank 241-AZ-151

Tank 241-AZ-151, as well as other catch tanks, received waste drained from diversion boxes, valve pits, diverter stations, and other DST equipment. Condensate from various systems routinely drained into some of the catch tanks. Line flush solutions also could drain into the tanks during jumper changes. In the past, rainwater intrusions through defective weather-tight valve pits drained into the tanks and contributed to the annual volume accumulations of liquid in these tanks. However, the implementation of Project W-030 was since minimized the rain intrusion due to pit modification that improved seals.

Tank equipment (components) such as a pump, a pump-out jumper, a pump-out line, and associated liquid level monitoring probes exists as part of the catch tank system. The presence of these components in the tank further identified the need to stabilize the tank to complete initial decommissioning.

The volume of 241-AZ-151 was controlled administratively to a predetermined level in accordance with the Tank Farm operating specifications OSD-T-151-0015 (Reberger 1995). The majority of the accumulations in the catch tank, such as condensate collection, were expected. Rain intrusions formed the bulk of the unexpected accumulations.

The 241-AZ-151 Tank is operational at the time of this study, which inherently disqualified it from being classified as initially decommissioned. The identification of tank components, effluent sources (identified above and in Table 1-1), and the identification of liquid present in the tank were included to further define the problem and document the conditions to be mitigated.

4.2 Isolation Of Tank 241-AZ-151

Tank 241-AZ-151 receives waste drained from the 241-AZ-101 and –102 vent header seal loops, AZ Tank farm Leak detection pits, 241-AZ-801A instrumentation building floor drain, process condensate from the 241-AZ-702 Ventilation Building, and 241-AZ-152 sluicing transfer box floor drain. Each of these lines, also shown on Table 1-1, physically entered the tank at locations shown on the attached Drawing H-2-68316, Appendix B. All of these lines are not individually controlled by administrative and/or engineering controls, which disqualified the tank from being classified as initially decommissioned.

The identification of effluent sources above and in Table 1-1, and the identification of liquid present in the tank were included to further define the problem and document the conditions to be mitigated.

4.3 Monitoring Of Tank 241-AZ-151

The method of liquid-level monitoring for Tank 241-AZ-151, while in operation, was by Food Instrument Corporation (FIC) gauges and later by an ENRAF system. Many underground storage tanks liquid levels in the 200 East and 200 West Area tank farms are measured by automatic ENRAFs, and read by Tank Monitoring and Control System (TMACS) equipment. An ENRAF consists of a sight glass, control box, and flush spray attachments. ENRAF Series 854 level gauges are certified by Factory Mutual for the National Fire Protection Association (NFPA 70, *The National Electric Code*) hazardous Class I, Division 1, Groups B, C, and D Locations. The measuring principle for these gauges is based on the detection of variations in the weight of a displacer suspended in the process fluid. The displacer is connected to a wire wound on a precision measuring drum.

5.0 ALTERNATIVE IDENTIFICATION AND DISCUSSION

The following section documents the identification of alternatives that were feasible with respect to Tank Farm acceptable practices and that met the intent of the criteria set forth for accomplishing initial decommissioning. The initial decommissioning criteria and the correlating definitions are listed below:

- Stabilization – Liquids and waste removal within twelve (12) months, or sooner, from the date of removal from service.
- Isolation – Administrative and/or engineering controls in place to prevent use within twelve (12) months, or sooner, from the date of removal from service.
- Monitoring – Equipment and frequency to be employed to ensure each component remains free of liquids and waste upon removal from service, to be in place within twelve (12) months or sooner, from the date of removal from service.

Subsequently, the following sections included alternatives specific to accomplishing each of the above criteria.

5.1 241-AZ-151 Tank Stabilization Alternatives

Section 4.1 included the problems associated with the current configuration and operation of the tank, with respect to stabilization. Each of the stabilization options identified had common steps associated with the removal of tank liquid and equipment. The first and second steps in stabilization, for each option, consisted of pumping the tank liquid through the pump-out jumper and pump-out line (to the associated diversion box) and removal of tank equipment/components. Pumping the tank would require that the Tank Waste Remediation System (TWRS) operations administered approved procedures in a manner consistent to many other pump operations with respect to catch tanks. The removal of equipment would be an integrated process among facilities operations and engineering personnel, safety (radiation and hazardous chemical protection) personnel, and crafts or maintenance personnel. For removal of equipment from the tank, TWRS operations and engineering, radiation and chemical safety, and crafts or maintenance personnel would need to evaluate the planned activity before starting work in a hazardous (potentially contaminated) area. Based on the activity and the known or suspected hazards, the evaluation would determine what protective measures are required to maintain As Low As Reasonably Achievable (ALARA). Additional protective measures could include pre-job planning; flammable gas, radiation, and toxicological monitoring; and providing temporary confinement structures, temporary shielding, spark resistant tools, in-tank or in-pit decontamination spray wands, cranes, fixtures (e.g., positioning guides); or waste packaging, handling, and disposal.

These steps were typical throughout all stabilization options as they were the only feasible means of removing the liquid and waste from the tank, in a timely manner. The following sections identified options to change the tank configuration, after tank liquid is pumped and the equipment removed, to one consistent with initial decommissioning.

5.1.1 Stabilization Option 1

A highly effective way to complete stabilization of the catch tank would be to physically remove the tank. Upon completion of pumping activities, waste removal activities, and after isolation had occurred, the tank could be excavated and removed. Although removal of the tank was characterized in this study as an option specific to stabilization, it would obviously eliminate the need to monitor and enhance the level of isolation.

To physically remove 241-AZ-151 Tank, major excavation and removal efforts would be required (see Drawing H-2-68316, Appendix B for the general tank configuration). Significant amounts of large earth moving and crane and hoisting equipment would be needed to safely excavate and remove the tank. This option would consist of excavation of the perimeter to a depth of twenty five (25) feet below grade (500 cubic yards), removal of 100 ton load with crane and load onto trailer, relocation and burial of the tank (1,750 cubic feet). If this option were chosen in conjunction with Options 1 or 2 of Sections 5.2.1 or 5.2.2, respectively, the cost associated with completing tank removal would be diminished, as some excavation would be accomplished prior to tank removal.

5.1.2 Stabilization Option 2

An effective means of stabilizing the tank upon completion of the common steps required for all stabilization options would be no action. No action beyond the common steps would be required to adequately compete initial decommissioning with respect to stabilization. Pumping the tank liquid coupled with equipment removal would ensure that liquids and wastes were removed within twelve (12) months, or sooner, from the date of removal from service.

5.2 241-AZ-151 Tank Isolation Alternatives

Section 4.2 included the problems associated with the current configuration and operation of the tank, with respect to isolation. Each of the isolation options identified will have a common future configuration associated with the rerouting of the process condensate line (PC-AZ503-M27) and a common step with respect to the installation of a tank cover.

The common future configuration with respect to isolation, for each option, will consist of the previous rerouting of the line as illustrated in the attached Drawing ESW-521-M5, Appendix B. The PC-AZ503-M27 rerouting would include rerouting the line from 241-AZ-702 building to Tank 241-AZ-102, Riser 14F (or 15F, 15G, 151 or 15 H). The line would connect to riser approximately five (5) feet above tank connection, resulting in a slope that would be one eighth (1/8) inch per foot or better. This rerouting would be part of a different activity and discussed here for information purposes only.

The common step with respect to isolation would be to provide a cover to the tank. Minimization of the rain infiltrations into the catch tank would be essential and achievable by sealing the access points of the rain intrusions. Flexible membranes made of chlorosulfonated polyethylene (or polyurea or other polymer substances) are ideal for use as weather covers for placement on the tank. There were no options concerning the cover materials as many are suitable and similar in function and cost, and provide no significant basis for comparison. The general configuration of the weather cover to be installed was shown in Figure 5-1. The tank would be covered with a cover block (modified for monitoring) consistent with other covers utilized to isolate inactive components. This activity, along with all identified in these isolation options would include operations and engineering planning consistent with Tank Farm under ground line maintenance, installation, or removal activities similar to those steps identified in Section 5.1.

5.2.1 Isolation Option 1

An effective way to isolate the lines penetrating the tank would be to cut and cap the lines at the tank location. This would involve excavating around the perimeter of the tank, locating the lines (see Table 1-1 for line identification and elevations), and cutting and capping the lines in place. Cutting and capping the lines would result in isolation of both the tank and the lines leading to the tank. The cutting and capping process identified in this option would be similar to that completed for Project W030, Tank Farm Ventilation Upgrade (see attached Drawing H-2-131087, Rev. 2, sheet 3, Appendix B). Again, the applicable planning and implementation requirements referenced in Section 5.1 would need to be applied to effectively complete the individual line isolations.

5.2.2 Isolation option 2

Another way to isolate the tank would be to accept the assumption which states all lines, with the exception of PC-AZ503-M27, are inactive, and simply cut the lines and leave them uncapped. This would include some excavating (would require less precise and less intensive excavation as capping would not be performed) around the perimeter of the tank, locating and cutting the lines near the exterior of the tank structure.

5.2.3 Isolation Option 3

A less effective means of isolating the tank would be to consider all lines, with the exception of PC-AZ503-M27, inactive and leave in place. This would result in no action, accepting the assumption that inactive lines would not leak or flow into the tank.

5.2.4 Isolation Option 4

The last option for isolation of the 241-AZ-151 Tank would be to locate and isolate each line at the facility from which they originated. This would involve finding the effluent points of each line at the originating facility and examine whether the lines had been grouted, blanked, or capped in some manner acceptable with respect to pipe isolation. The results of these examinations would most likely lead to excavation at numerous facilities and sites throughout the Tank Farm Area to ensure no liquid could leak or flow to the 241-AZ-151 Tank.

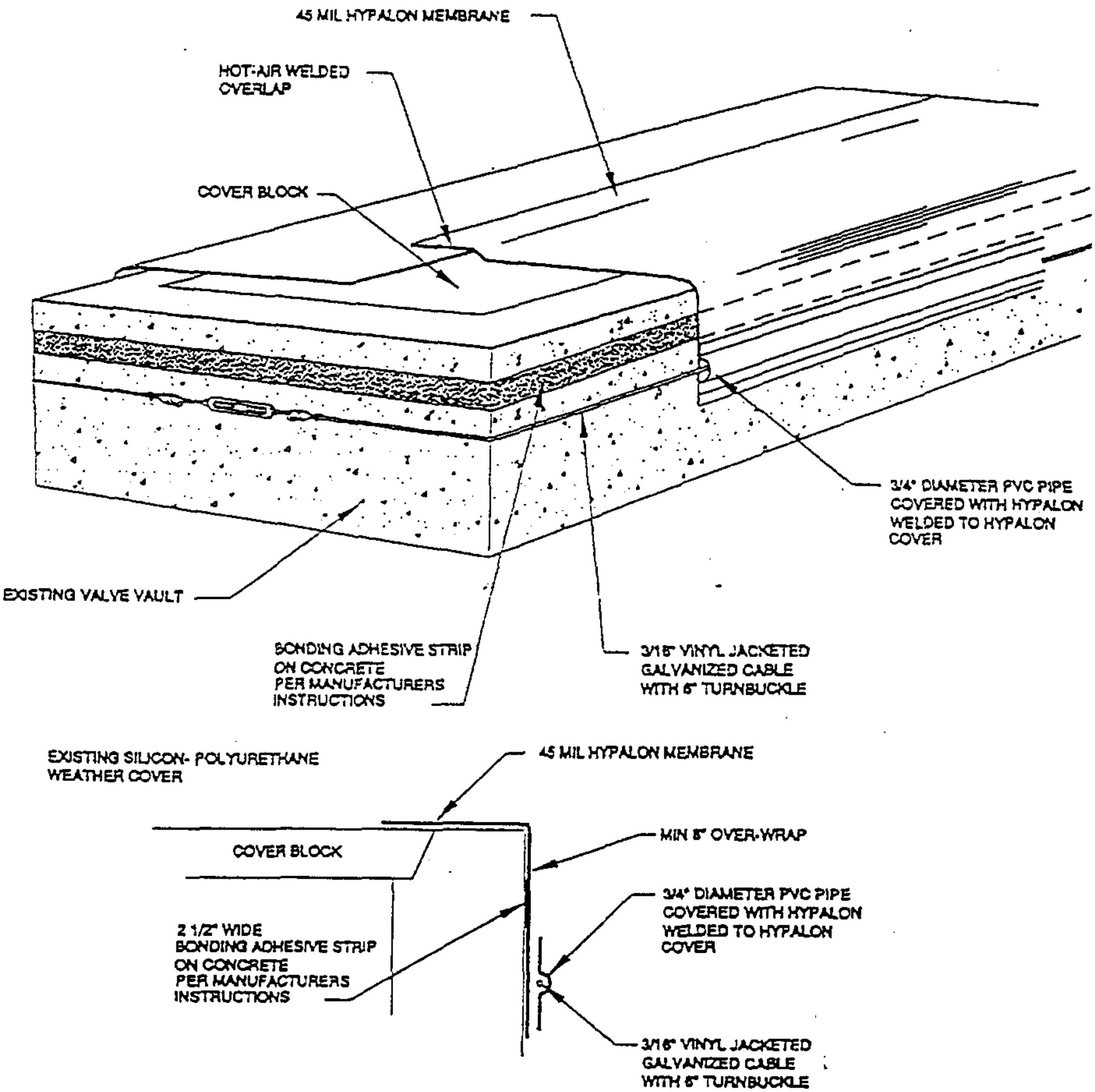


Figure 5-1. Weather Cover for Concrete Structures.

5.3 241-AZ-151 Tank Monitoring Alternatives

Section 4.3 includes the identification of the current configuration and operation of the tank, with respect to monitoring.

5.3.1 Monitoring Option 1

One effective way to monitor the tank after the isolation had been completed would be to install a simple manual tape through the tank cover. Three types of manual tapes are used in RPP tanks. The flake-box type, described here, is simple and of a more recent design. The older types include a vertically mounted exposed tape reel and a horizontal mounted encased tape reel. Despite their differences, all operate in essentially the same manner. A reel is permanently attached to the tank, and the measuring tape is attached to the reel. The measuring tape would be inserted through a hole in the tank cover. Readings would be obtained by attaching a portable direct current meter to the terminals provided at the tank. The zero position on the manual tape would represent the bottom of the tank or sump.

5.3.2 Monitoring Option 2

One alternative to monitor the tank upon completion of isolation and stabilization would be to leave the current monitoring apparatus in place. This would entail no action. The ENRAF would be left in place and utilized as currently operated. A level change would cause a change in weight of the displacer, which would be detected by the gauge force transducer. Electronics within the gauge would cause a servo motor to adjust the position of the displacer and compute the tank level on the basis of the new position of the displacer drum. The gauge would display the level in decimal inches. A digital output signal would transmit the level data for remote data processing.

5.4 Cost Identification

Table 5-1 included the cost associated with the alternatives relative to stabilization, isolation, and monitoring. The table included initial costs of installation or implementation and life cycle costs of maintenance and operation. Dollar amounts reflect rough order of magnitude (ROM) estimates of direct construction and modification costs and were meant for estimation purposes only. The estimates contained in this report did not include the cost of engineering, construction management, CHG adders, escalation, contingency, site allocation, and other projects costs.

Table 5-1. Option/Cost Identification.

Item	Description	ROM Estimate
	Stabilization Alternatives	
Option #1 Costs	Base Costs for Stabilization	$1,290,000
Pump and stabilize tank	Pump tank to remove all remaining liquid. Remove equipment (pump, jumper, etc). (assumes $20K to pump and $35K to remove equipment)	$55,000
Remove Tank	Excavate perimeter to a depth of 25 feet below grade. Remove 100 ton load with crane and onto trailer. Relocate and bury the tank (1,750 cu. ft). (assumes excavation $225K and $290K backfill and $20K shoring and tank removal $500K and tank relocation $200K	$1,235,000
Option #2 Costs	Base Costs for Stabilization	$55,000
Pump and stabilize tank	Pump tank to remove all remaining liquid. Remove equipment (pump, jumper, etc). (assumes $20K to pump and $35K to remove equipment	$55,000
No Action	Leave Tank in place	0
	Isolation Alternatives	
Option #1 Costs	Base Costs for Stabilization	$540,000
Cut and cap lines at the tank	Excavate perimeter to a depth of 15-20 feet below grade. Cut and cap lines. (assumes excavation $200K and $250K backfill and $60K modification	$510,000
Install cover to tank	Install new cover on tank/or modify existing cover. (assumes $30K)	$30,000
Option #2 Costs	Base Cost for Isolation	$420,000
Install cover to tank	Install new cover on tank/or modify existing cover. (assumes $30K)	$30,000
Cut lines at tank	Locate and cut lines at tank perimeter. (assumes excavation $150K and $200K backfill and $40K modification)	$390,000
Option #3 Costs	Base Cost for Isolation	$30,000
Install cover to tank	Install new cover on tank/or modify existing cover. (assumes $30K)	$30,000
No Action	Leave lines in place	0
Option #4 Costs	Base Cost for Isolation	$590,000
Install cover to tank	Install new cover on tank/or modify existing cover. (assumes $30K)	$30,000
Locate and isolate lines at the originating facility	Investigate effluent lines from originating facility and locate and isolate. (assumes excavation $200K and, $210K backfill, and modifications $150K)	$560,000

Item	Description	ROM Estimate
	Monitoring Alternatives	
Option #1 Costs	Base Cost for Monitoring	$54,000
Manual tape monitoring	Install and periodically operate on manual tape monitoring system. (assumes $45,000 installation and $1,500 per monitoring period)	$54,000
Option #2 Costs	Base cost for monitoring	$10,000
ENRAF/TMACS monitoring	Automated and computerized monitoring system. (assumes $10,000 maintenance and operation costs)	$10,000

6.0 ALTERNATIVE EVALUATION

Section 5.0 discussed various alternatives identified in Section 4.0. This section ranked the alternatives according to the effectiveness, initial costs, and life-cycle costs. The ranking system is based on information gathered from the appropriate Design Authorities, current safety analysis documents, the *Operational Summaries for Auxiliary Facilities* WHC-SD-WM-SARR-008 Rev.0, (Ryan 1994) and process and engineering knowledge of the TWRS Project. The capability of each alternative was ranked according to three criteria:

1) The effectiveness of the alternative to remedy the issue. A high, moderate, or low ranking was subjectively assigned to an alternative to provide a measurement of how well the alternative corrects the particular issue. A high ranking means that the remedy was very effective in correcting the deficiency; a low ranking indicates that the remedy would have little or no impact on correcting the deficiency.

2) The initial cost of implementing the measure was associated with design, procurement, and construction. The ranking of high was assigned to systems/concepts with an estimated initial cost greater than $1 million. Moderate was assigned to systems/concepts with an estimated initial cost greater than $150,000 and less than $1 million. Low initial cost ranking applied to systems/concepts that cost less than $150,000.

3) The estimated life-cycle costs associated with each alternative were the expenditures associated with long-term use of the system/concept, as they applied to Project W-521 only. The designations within this category were subjectively assigned, as the systems/concepts life-cycle costs should be negligible (i.e., the options were chosen as decommissioning alternatives, which by nature should not have long-term costs associated with them).

The alternatives were compared and quantitatively assigned high, moderate or low ranking for their capacity to accomplish the criteria with respect to effectiveness and cost. The rankings were weighted differently, a multiplier of 3 for the effectiveness, a multiplier of 1 for initial costs, and a multiplier of 2 for life-cycle costs. This weighting system was used to provide the best ranking of each alternative with respect to decommissioning. The Table 6-1 illustrates the rankings.

Table 6-1. Alternative Evaluation Matrix.

Corrective Action Alternative	Effectiveness			Initial Cost			Life-Cycle Cost			Total Points
Weighting Factor	3			1			2			
Ranking	H	M	L	H	M	L	H	M	L	
Points	10	5	1	1	5	10	1	5	10	
241-AZ-151 Tank Stabilization										
Option 1	✓			✓					✓	51
Option 2	✓					✓			✓	60
241-AZ-151 Tank Isolation										
Option 1	✓				✓				✓	55
Option 2		✓			✓				✓	40
Option 3			✓			✓			✓	33
Option 4		✓			✓				✓	40
241-AZ-151 Tank Monitoring										
Option 1	✓					✓		✓		50
Option 2	✓					✓			✓	60

7.0 CONCLUSIONS

Section 6.0 compared and quantitatively assigned values to each alternative identified in Section 5.0. This section interprets the findings from Section 6.0 and documented the rational associated with selecting the best option with respect to stabilization, isolation, and monitoring of 241-AZ-151 Tank. Also, this section recommended a path-forward, a combination of the best alternatives from each aspect of initial decommissioning, to be considered the preferred alternative.

7.1 Stabilization

The stabilization option that scored the best was Option 2 (with a score of 60). Option 2 included pumping the tank liquid, removing the tank components, and leaving the tank in place. Option 2 was determined to be better suited for initial decommissioning as the initial costs would be lower than Option 2. Both Option 1 and 2 would be effective in stabilizing the tank yet the initial costs associated with Option 1, even if the costs were diminished due to prior excavation, would far exceed the cost estimated for Option 2.

7.2 Isolation

The isolation option that scored the best was Option 1 (with a score of 55). Option 1 included isolating the tank by excavating around the perimeter of the 241-AZ-151 and cutting and capping the incoming lines at the tank. Options 2 and 3 scored well in the initial costs category yet the effectiveness was uncertain, as the lines would have to be assumed inactive. Although the assumption, concerning the lines inactiveness (see Appendix A), was considered and documented in this study, the option evaluation ranked those options that required the lines to be inactive at a lower value. The initial costs associated with Option 4 were determined to be higher than Option 1, and the effectiveness rated lower (more uncertainty with respect to line leakage into the tank).

7.3 Monitoring

The monitoring option that scored the best was Option 2 (with a score of 60). Option 1 included monitoring the tank with a simple manual tape (flake-box type) that would protrude through the tank cover and be read at an interval to ensure no liquids were present in the tank. Option 1 scored lower in the life-cycle cost due to a greater potential and cost associated with maintenance and component replacement. Option 2 was determined to be as effective as Option 1 and determined to be less expensive due to the ENRAF current configuration and usability.

7.4 Recommendation

As discussed in Sections 2.0 and 2.1, the alternative that scored the best for each action of initial decommissioning (stabilization, isolation, and monitoring), was chosen and combined with the best alternative for the other actions to form the preferred alternative. The previously stated rational combined with the evaluation scoring, provided the basis for the following recommendation.

The recommendation that resulted from the alternative analysis was to perform initial decommissioning as follows: 1) stabilize the tank by pumping the tank liquid and removing the tank equipment (Option 2); 2) isolate the tank by excavating around the perimeter of the tank and cutting and capping the incoming lines, and installing a weather cover on tank (Option 1); and 3) monitor the tank, upon completion of stabilization and isolation, by operating the ENRAF monitoring system currently in place (Option 2).

8.0 REFERENCES

DOE, *"Decommissioning Resource Manual,"* DOE/EM-0246, Department of Energy, Hanford, Richland, WA.

HNF-1997, *"Catch Tank Code Compliance Evaluation and Alternatives,"* HNF-SD-TWR-ES-005, Rev. 0, Hanford, Richland, WA.

HNF-1999, *"Guidance for Alternative Generation and Analysis, Volume IV Engineering,"* HNF-IP-0842, Rev. 1e, Hanford, Richland, WA.

Palit, A. N., 1996, *Letter Report, "Catch Tanks Inhibitor Addition 200 East and 200 West Areas,"* WHC-SD-WM-ER-573, Rev. 0, prepared by ICF Kaiser Hanford Company for Westinghouse Hanford Company, Richland, WA.

Reberger, D. W., 1995, *"Operating Specifications for Miscellaneous Facilities,"* OSD-T-151-00015, Rev. B-6, Westinghouse Hanford Company, Richland, WA.

Ryan, G. W., 1994, *"Operational Summaries for Auxiliary Facilities,"* WHC-SD-WM-SAAR-008, Westinghouse Hanford Company, Richland, WA.

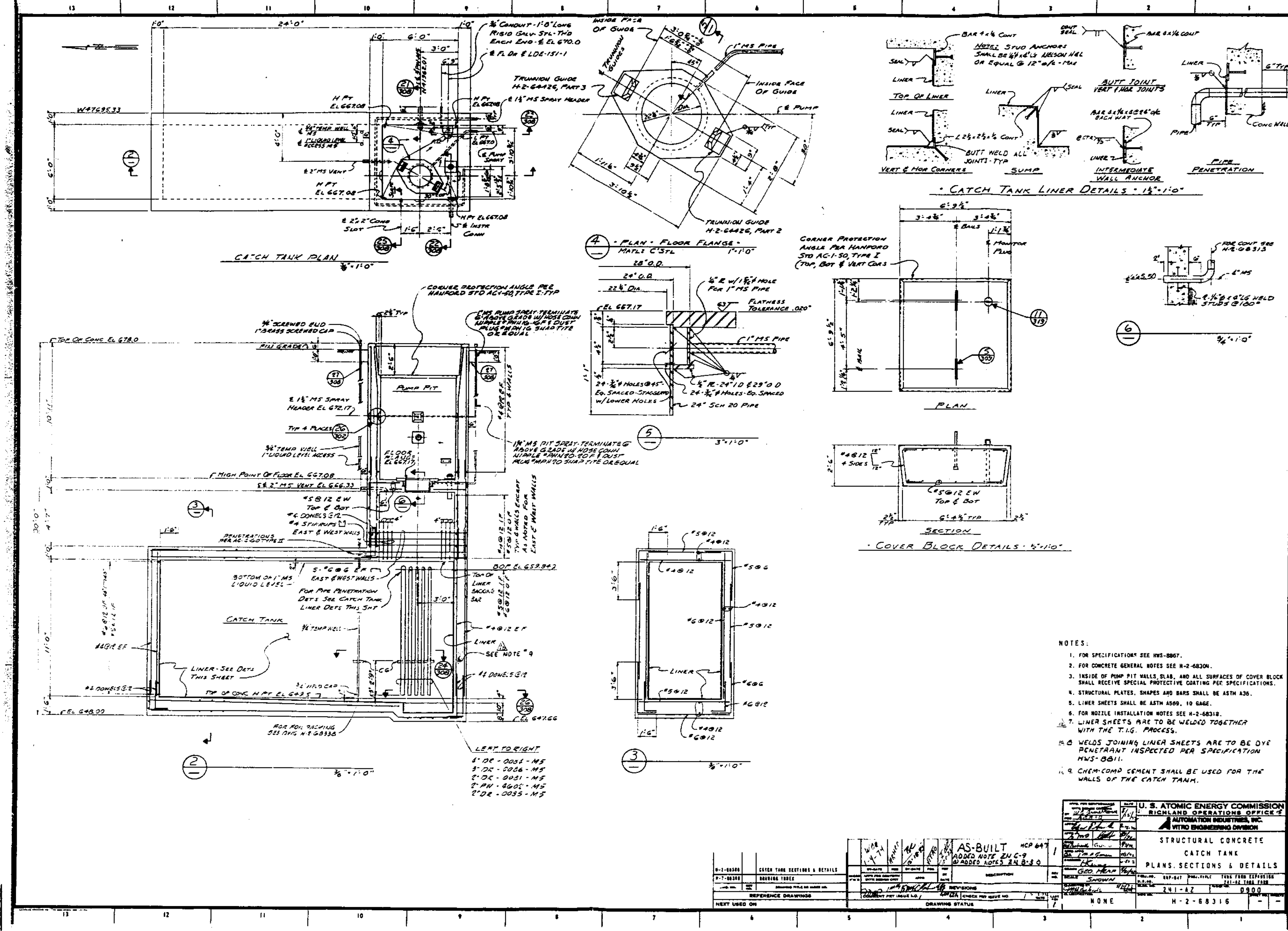
Silver, D., 2000, *"Letter-Administration Order,"* Order No. 00NWPKW-1251, State of Washington Department of Ecology, Olympia, WA.

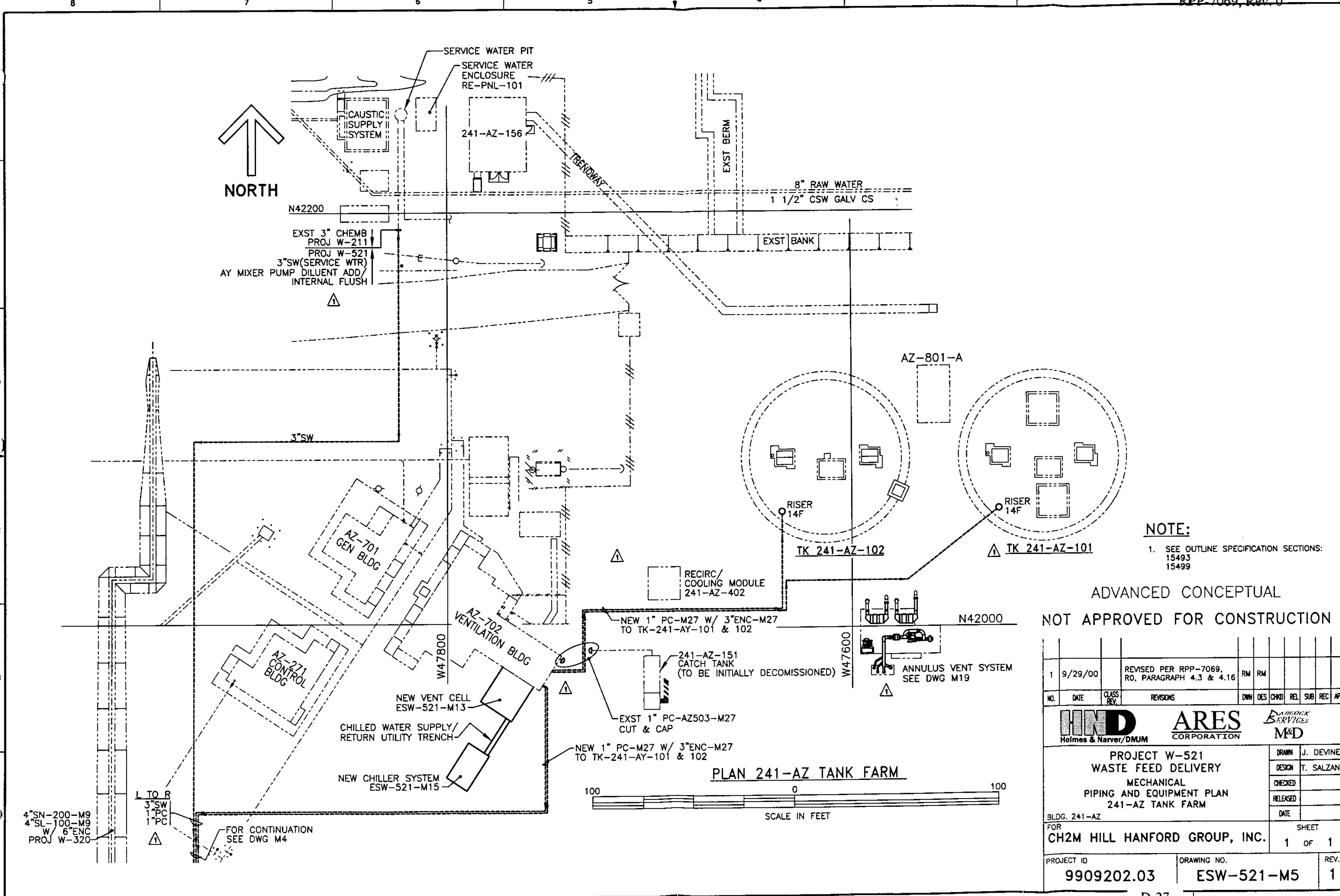
Tiffany, M. S., 1995, *"Catch Tanks Accumulations, Don't Say It- Write It to R. A. Dodd,"* Westinghouse Hanford Company, Richland, WA.

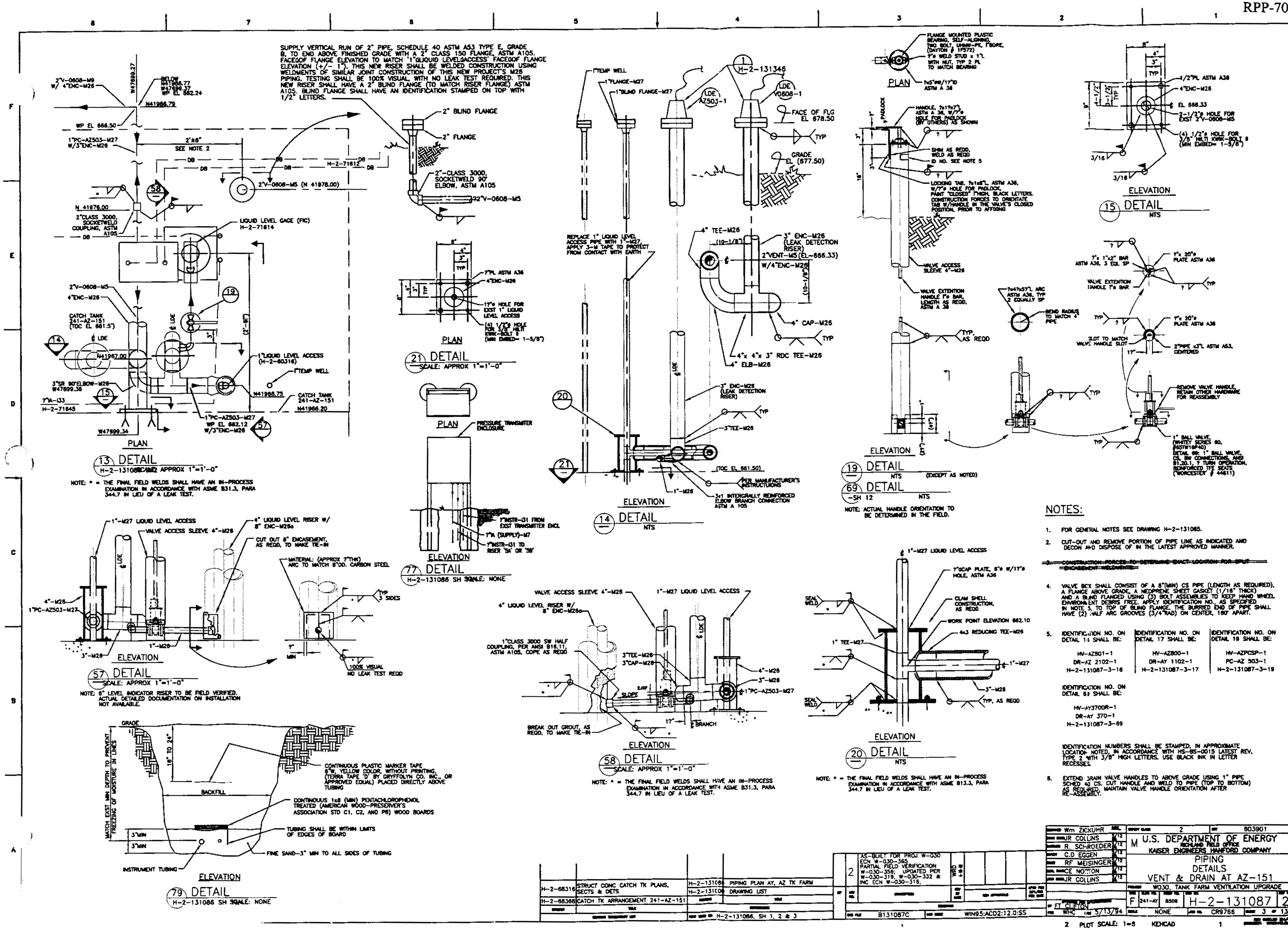
Appendix A
241-AZ-151 Tank Line Status

LINE ID	DISPOSITION	ACTION
2"-DR-0085-M5	DETERMINED TO BE INACTIVE PER TWRS DESIGN AUTHORITIES	NO ACTION
2"-PW-4602-M5 (4603/4602 & 4604/4602)	UNCERTAIN	NEED TO CONFIRM LINE STATUS
2"-DR-0081-M5	DETERMINED TO BE INACTIVE PER TWRS DESIGN AUTHORITIES	NO ACTION
3"-DR-0086-M5	UNCERTAIN	NEED TO CONFIRM LINE STATUS
3"-PW-4605-M5	DETERMINED TO BE INACTIVE PER TWRS DESIGN AUTHORITIES	NO ACTION
4"-DR-0084	UNCERTAIN	NEED TO CONFIRM LINE STATUS
2"-V-0608-M5	DETERMINED TO BE INACTIVE PER TWRS DESIGN AUTHORITIES	NO ACTION
½"-151-IA (HI)-M9	DETERMINED TO BE INACTIVE PER TWRS DESIGN AUTHORITIES	NO ACTION
½"-151-IB (LO)-M9	DETERMINED TO BE INACTIVE PER TWRS DESIGN AUTHORITIES	NO ACTION
½"-151-IC (MED)-M9	DETERMINED TO BE INACTIVE PER TWRS DESIGN AUTHORITIES	NO ACTION
1½"-RW-3603-M5	UNCERTAIN	NEED TO CONFIRM LINE STATUS
1"-RW-36020M5	UNCERTAIN	NEED TO CONFIRM LINE STATUS
1"-PC-AZ503-M27	W-521 SCOPE TO REROUTE	NO ACTION

Appendix B
Reference Drawings


CATCH TANK PLAN
CATCH TANK LINER DETAILS · 1½"=1'-0"
PLAN · FLOOR FLANGE · MAT'L: C'STL
COVER BLOCK DETAILS · ½"=1'-0"
PLAN
SECTION
CATCH TANK
PUMP PIT
NOTES:
1. FOR SPECIFICATIONS SEE HWS-8867.
2. FOR CONCRETE GENERAL NOTES SEE H-2-6830N.
3. INSIDE OF PUMP PIT WALLS, SLAB, AND ALL SURFACES OF COVER BLOCK SHALL RECEIVE SPECIAL PROTECTIVE COATING PER SPECIFICATIONS.
4. STRUCTURAL PLATES, SHAPES AND BARS SHALL BE ASTM A36.
5. LINER SHEETS SHALL BE ASTM A569, 10 GAGE.
6. FOR NOZZLE INSTALLATION NOTES SEE H-2-68318.
7. LINER SHEETS ARE TO BE WELDED TOGETHER WITH THE T.I.G. PROCESS.
8. WELDS JOINING LINER SHEETS ARE TO BE DYE PENETRANT INSPECTED PER SPECIFICATION HWS-8811.
9. CHEM-COMP CEMENT SHALL BE USED FOR THE WALLS OF THE CATCH TANK.
AS-BUILT
U. S. ATOMIC ENERGY COMMISSION
RICHLAND OPERATIONS OFFICE
AUTOMATION INDUSTRIES, INC.
VITRO ENGINEERING DIVISION
STRUCTURAL CONCRETE
CATCH TANK
PLANS, SECTIONS & DETAILS
241-AZ
H-2-68316


SERVICE WATER PIT
SERVICE WATER ENCLOSURE RE-PNL-101
CAUSTIC SUPPLY SYSTEM
241-AZ-156
NORTH
TRENDWAY
EXST BERM
8" RAW WATER
1 1/2" CSW GALV CS
N42200
EXST BANK
EXST 3" CHEMB PROJ W-211
PROJ W-521
3"SW(SERVICE WTR)
AY MIXER PUMP DILUENT ADD/ INTERNAL FLUSH
3"SW
AZ-801-A
RISER 14F
TK 241-AZ-102
TK 241-AZ-101
NOTE:
1. SEE OUTLINE SPECIFICATION SECTIONS: 15493 15499
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
AZ-701 GEN BLDG
AZ-702 VENTILATION BLDG
AZ-271 CONTROL BLDG
RECIRC/ COOLING MODULE 241-AZ-402
NEW 1" PC-M27 W/ 3"ENC-M27 TO TK-241-AY-101 & 102
N42000
W47800
W47600
241-AZ-151 CATCH TANK (TO BE INITIALLY DECOMISSIONED)
ANNULUS VENT SYSTEM SEE DWG M19
NEW VENT CELL ESW-521-M13
CHILLED WATER SUPPLY/ RETURN UTILITY TRENCH
EXST 1" PC-AZ503-M27 CUT & CAP
NEW CHILLER SYSTEM ESW-521-M15
PLAN 241-AZ TANK FARM
100 0 100
SCALE IN FEET
L TO R 3"SW 1"PC 1"PC
4"SN-200-M9 4"SL-100-M9 W/ 6"ENC PROJ W-320
FOR CONTINUATION SEE DWG M4
1 9/29/00 REVISED PER RPP-7069, R0, PARAGRAPH 4.3 & 4.16 RM RM
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
BABCOCK SERVICES M&D
PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
PIPING AND EQUIPMENT PLAN
241-AZ TANK FARM
DRAWN J. DEVINE
DESIGN T. SALZANO
CHECKED
RELEASED
DATE
BLDG. 241-AZ
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1
PROJECT ID 9909202.03
DRAWING NO. ESW-521-M5
REV. 1


SUPPLY VERTICAL RUN OF 2" PIPE, SCHEDULE 40 ASTM A53 TYPE E, GRADE B, TO END ABOVE FINISHED GRADE WITH A 2" CLASS 150 FLANGE, ASTM A105. FACEOF FLANGE ELEVATION TO MATCH "1"LIQUID LEVELACCESS" FACEOF FLANGE ELEVATION (+/- 1"). THIS NEW RISER SHALL BE WELDED CONSTRUCTION USING WELDMENTS OF SIMILAR JOINT CONSTRUCTION OF THIS NEW PROJECT'S M26 PIPING. TESTING SHALL BE 100% VISUAL, WITH NO LEAK TEST REQUIRED. THIS NEW RISER SHALL HAVE A 2" BLIND FLANGE (TO MATCH RISER FLANGE) ASTM A105. BLIND FLANGE SHALL HAVE AN IDENTIFICATION STAMPED ON TOP WITH 1/2" LETTERS.
PLAN
13 DETAIL
SCALE: APPROX 1"=1'-0"
NOTE: * = THE FINAL FIELD WELDS SHALL HAVE AN IN-PROCESS EXAMINATION IN ACCORDANCE WITH ASME B31.3, PARA 344.7 IN LIEU OF A LEAK TEST.
PLAN
21 DETAIL
SCALE: APPROX 1"=1'-0"
ELEVATION
77 DETAIL
H-2-131086 SH 3 SCALE: NONE
ELEVATION
14 DETAIL
NTS
ELEVATION
19 DETAIL
NTS (EXCEPT AS NOTED)
69 DETAIL
-SH 12 NTS
NOTE: ACTUAL HANDLE ORIENTATION TO BE DETERMINED IN THE FIELD.
ELEVATION
15 DETAIL
NTS
ELEVATION
57 DETAIL
SCALE: APPROX 1"=1'-0"
NOTE: 8" LEVEL INDICATOR RISER TO BE FIELD VERIFIED. ACTUAL DETAILED DOCUMENTATION ON INSTALLATION NOT AVAILABLE.
ELEVATION
58 DETAIL
SCALE: APPROX 1"=1'-0"
NOTE: * = THE FINAL FIELD WELDS SHALL HAVE AN IN-PROCESS EXAMINATION IN ACCORDANCE WITH ASME B31.3, PARA 344.7 IN LIEU OF A LEAK TEST.
ELEVATION
20 DETAIL
NTS
NOTE: * = THE FINAL FIELD WELDS SHALL HAVE AN IN-PROCESS EXAMINATION IN ACCORDANCE WITH ASME B13.3, PARA 344.7 IN LIEU OF A LEAK TEST.
ELEVATION
79 DETAIL
H-2-131086 SH 3 SCALE: NONE
NOTES:
1. FOR GENERAL NOTES SEE DRAWING H-2-131085.
2. CUT-OUT AND REMOVE PORTION OF PIPE LINE AS INDICATED AND DECON AND DISPOSE OF IN THE LATEST APPROVED MANNER.
~~3. CONSTRUCTION FORCES TO DETERMINE EXACT LOCATION FOR SPLIT ENCASEMENT WELDMENTS.~~
4. VALVE BOX SHALL CONSIST OF A 8"(MIN) CS PIPE (LENGTH AS REQUIRED). A FLANGE ABOVE GRADE, A NEOPRENE SHEET GASKET (1/16" THICK) AND A BLIND FLANGED USING (3) BOLT ASSEMBLIES TO KEEP HAND WHEEL ENVIRONMENT DEBRIS FREE. APPLY IDENTIFICATION NO., AS SPECIFIED IN NOTE 5, TO TOP OF BLIND FLANGE. THE BURRIED END OF PIPE SHALL HAVE (2) HALF ARC GROOVES (3/4"RAD) ON CENTER, 180° APART.
5. IDENTIFICATION NO. ON DETAIL 13 SHALL BE: HV-AZ801-1, DR-AZ 2102-1, H-2-131087-3-16
IDENTIFICATION NO. ON DETAIL 17 SHALL BE: HV-AZ800-1, DR-AY 1102-1, H-2-131087-3-17
IDENTIFICATION NO. ON DETAIL 19 SHALL BE: HV-AZPCSP-1, PC-AZ 503-1, H-2-131087-3-19
IDENTIFICATION NO. ON DETAIL 69 SHALL BE: HV-AY3700R-1, DR-AY 370-1, H-2-131087-3-69
IDENTIFICATION NUMBERS SHALL BE STAMPED, IN APPROXIMATE LOCATION NOTED, IN ACCORDANCE WITH HS-BS-0015 LATEST REV. TYPE 2 WITH 3/8" HIGH LETTERS. USE BLACK INK IN LETTER RECESSES.
6. EXTEND DRAIN VALVE HANDLES TO ABOVE GRADE USING 1" PIPE SCHED 40 CS. CUT HANDLE AND WELD TO PIPE (TOP TO BOTTOM) AS REQUIRED. MAINTAIN VALVE HANDLE ORIENTATION AFTER RE-ASSEMBLY.
H-2-68316 STRUCT CONC CATCH TK PLANS, SECTS & DETS
H-2-68366 CATCH TK ARRANGEMENT 241-AZ-151
H-2-131086 PIPING PLAN AY, AZ TK FARM
H-2-131006 DRAWING LIST
H-2-131086, SH 1, 2 & 3
2 AS-BUILT FOR PROJ W-030 ECN W-030-365 PARTIAL FIELD VERIFICATION W-030-356; UPDATED PER W-030-319, W-030-332 & INC ECN W-030-318.
Wm ZICKUHR
JR COLLINS
R. SCHROEDER
C.D EGGEN
RF MEISINGER
CE NORTON
JR COLLINS
M U.S. DEPARTMENT OF ENERGY
RICHLAND FIELD OFFICE
KAISER ENGINEERS HANFORD COMPANY
PIPING
DETAILS
VENT & DRAIN AT AZ-151
W030, TANK FARM VENTILATION UPGRADE
F 241-AY 8500 H-2-131087 2
NONE CR9766 3 of 13
B131087C
WIN95:ACD2:12.0:SS
WHC 5/13/94
603901
PLOT SCALE: 1=8
KEHCAD

Attachment E

Attachment E

Comparison of Fuel Oil Boiler to Electric Heating System

COMPARISON OF FUEL OIL BOILER TO ELECTRIC HEATING SYSTEM

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46
Report No. 990920203-012
ACDR Subtask 5
Revision 0

September 2000

prepared by

HND TEAM

COMPARISON OF FUEL OIL BOILER TO ELECTRIC HEATING SYSTEM

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-012
ACDR Subtask 5
Revision 0

September 2000

Prepared by: Richard L. Golberg, P.E.

Approved by: R L Fritz
Robert L. Fritz

Date: 9-29-00

Table of Contents

Tables

Acronyms

BHP	Boiler Horsepower
CDR	Conceptual Design Report
BTU	British Thermal Unit

1.0 INTRODUCTION

Project W-521, Waste Feed Delivery Systems, is installing a diluent and flush system at both the SY farm in the 200 West Area and the AW farm in the 200 East Area. These systems will supply treated water for in-tank and in-line dilution, pipe pre-heating, and line flushing for low activity waste (LAW) and high-level waste (HLW) transfers including intra-farm transfers, inter-farm transfers, and transfers to the Waste Treatment Facility (WTF). The major components of these systems consist of chemical tanker offload equipment, a packaged water heater with associated support equipment, metering pumps for chemical injection, a static mixing tee, a mixing and storage tank, supply pumps, valves, piping, and instrumentation used for monitoring and control.

During the conceptual design phase of the project, various questions and concerns were raised about the capabilities and layout of these two systems. Also, since preparation of the CDR, numerous changes have been made to the requirements contained in the Level 2 specification, HNF-4163, *Double-Shell Tank Diluent and Flush Subsystem Specification*. In order to address all of these items, several tasks were undertaken as part of the Advanced Conceptual Design (ACD) effort. These included: 1) comparing using fuel oil versus an electric water heating system, see *Comparison of Fuel Oil Boiler to Electric Heating System for Project W-521, Diluent Supply*, Rev. 0, Report 990920203-012, 2) optimizing the pad design to minimize accumulation of water and 3) refining the diluent system piping tie-ins.

1.1 Purpose

The purpose of this task was to investigate the feasibility of using an electric water heater for the 241-AW and 241-SY diluent and flush system and to compare the results of this investigation against the fuel oil boiler approach in the W-521 Conceptual Design Report (CDR).

1.2 Scope

This comparison took the base system proposed in the W-521 CDR and then, reviewed the new Level 2 Specification HNF-4163 Rev 0 to determine what, if any, requirements had changed for the diluent and flush system. Based upon the results of this review and additional information provided by CHG personnel (see Section 4), electrical loading calculations were prepared to determine the electrical system requirements necessary to provide sufficient capacity to support all functions required of the system. Once the feasibility was established, cost evaluations were prepared, and a recommendation of the feasibility of utilizing an electric system was then completed.

2.0 METHODOLOGY

The approach to completing this task consisted of executing the following activities:

- Determining the flow and temperature requirements for heated water supplied by the diluent and flush system for the five different operations identified. These operations are:

- Waste Transfer Line Preheat,
- In-line Dilution,
- Transfer and Line Flush,
- In-tank Dilution, and
- Tank-heel Flushing.

- Narrowing the viable alternatives to an oil fired boiler (current baseline) and electric heaters through discussions with operations,
- Evaluating each of the two options (diesel boiler and electric heater) for their ability to meet the flow and temperature (as well as all other technical and safety) requirements,
- Calculating the required kW, boiler horsepower (BHP) and BTU/hr requirement for each of the five different operations,
- Determining the power available at the 241-AW and 241-SY facilities to support electric water heaters,
- Establishing the cost to provide required upgrades,
- Determining the relative cost of electric heating vs. fuel oil heating, and
- Recommending the most cost-effective solution which meets the technical requirements regardless of the heating method.

3.0 ASSUMPTIONS

The diluent and flush will utilize flush tanks with a capacity to hold enough heated water to perform the following functions:

- Waste transfer line preheat (two times the line volume),
- Transfer and line flush (two times the line volume) for 241-AW and (one times the line volume of the cross site transfer line piping volume) for 241-SY,
- In-line dilution prior to waste transfer (140 gpm for 30 minutes), and
- In-line dilution (331,200 gallons for 5 days).

The electric heaters for the AW tank farm will be sized based on the in-line dilution requirements.

When in-tank dilution or tank-heel flushing requires diluent with flows/temperatures outside the normal supply of the electric heater, it will be acceptable to utilize a temporary oil fired boiler to supplement the electric heaters.

4.0 DISCUSSION

The HNF-4163 Rev 0, *Double-Shell Tank Diluent and Flush Subsystem Specification* and HNF-4878 (Draft), *Requirements for Diluting and Flushing Double-Shelled Tank Systems* provided different values for water temperature, flow rate and volume for the five different flush operations. In discussions with CHG W-521 personnel (including the project design authority), it was decided to use the values in Table 4-1 for the 241-AW and 241-SY diluent and flush systems. These values were based on reasonable operating scenarios, the current transfer schedule allowances for unplanned needs, and are consistent with operational expectations.

Table 4-1. Diluent System Requirements

Operation	Required Temp (°F)	Flowrate (gpm)	Required Volume (Gal)	Required KW	Required BHP	Required Btu/hr
Waste Transfer Line Preheat	165	70	Two times line volume	1,179	120	4,024,782
In-line Dilution	155	53	331,200 (5 days)	815	83	2,782,349
	155	140 for 30 min		2,154	220	7,349,601
Transfer and Line Flush	104	160	Two times line volume	1,266	129	4,319,766
In-Tank Dilution	140	140	260,000	1,846	188	6,299,658
Tank-Heel Flushing	140	140	140,000	1,846	188	6,299,658

As can be seen form the table above, the bounding case for power required when an electric heating system is utilized is 2,154 kW.

Discussions with Dyncorp and Parsons Infrastructure and Technology Group on the power line capacity study RPP-6598 (Draft) for up to year 2012 indicates that there is sufficient capacity on the 13.8 kV C8-L8 line for 241-AW and the 13.8 kV C8-L4 line for 241-SY to supply power for utilizing an electric heating system.

During the definitive design process, the capability of existing electrical infrastructure, including incoming electrical lines and transformers shall be assessed. Dyncorp and Parsons Infrastructure and Technology Group, and Facility Electrical Engineering shall review and approve the assessment, any calculations, and electrical load design drawings. The design will either not exceed the current electrical capabilities, or provide for and required upgrades. The related facility calculation updates shall be completed and addressed as part of the project ABU.

Both systems (boiler and electric heater) meet all environmental requirements. The electric heater offers an advantage over the boiler system in the area of safety, since a significant source of flammable material (fuel oil tank) can be eliminated.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the technical cost and safety considerations noted above, an electric heating system for supplying heated water should be incorporated into the W-521 design of the diluent and flush system. This recommendation assumes the existing specification (HNF-4163, Rev. 0) will be modified (or a waiver obtained) to allow the flow and temperature valves discussed in this report to be utilized.

The following modifications should be incorporated in to the W-521, design for the AW system and the estimate adjusted accordingly.

- Two electric heaters rated at 412.5 kW each and a 10,000 gallon flush tank should be provided for the 241-AW system.
- The proposed 13.8 kV-480Y/277 V transformer for 241-AW should be resized from 1000 kVA to 2000 kVA.
- The 480Y/277V switchgear in the 241-AW ICE building should be resized to 3200 A.
- The 241-SY diluent flush system heating requirements should be attained with the installation of a additional electric heater and the existing system incorporated into the new design. The following modifications should be incorporated into the design for the SY system and the estimate adjusted accordingly:
- A new 325 kW heater (plus the two existing 500 kW heaters) and a 20,000 gallon flush tank should be provided in the SY system.
- An existing spare 800 A circuit breaker in the 252-SY switchgear should be used for the new heater.
- The two proposed 1500 kVA, 13.8 kV-480Y/277 V transformers for 241-SY will have sufficient capacity for the diluent flush heating system and should not be modified.

- The existing controls for the two 500 kVA heaters either require replacement or reprogramming as problems were encountered during the operations of the heaters during a recent transfer between SY-101 and SY-102.
- INDEECO electric hot water boilers should be procured as to match the existing type of heaters at 241-SY to reduce the type of spare parts.

5.1 Cost

The savings associated with these modifications is shown in Table 5.1.

Table 5-1. Cost

ELECTRIC HEATERS VS OIL FIRED BOILER – REDUCTION CDR ESTIMATE												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$18,489	-$3,400	-$16,633	-$1,156	-$1,541	-$578	-$385	-$1,156	-$770	-$7,384	-$7,984	-$11,652	-$71,128

6.0 SUMMARY

The use of electric heating will meet all technical and safety requirements, reduce the initial costs, reduce operational costs, improve the overall system reliability, and best supports Project W-521.

The drawings listed below have been revised to show this configuration.

- ESW-521-P7, Sht. 2,
- ESW-521-P7, Sht. 4,
- ESW-521-M12,
- ESW-521-M16,
- ESW-521-E1,
- ESW-521-E3, and
- ESW-521-E4, Sht. 2.

7.0 REFERENCES

HNF-4163 Rev 0, *Double-Shell Tank Diluent and Flush Subsystem Specification.*

HNF-4878 (Draft), *Requirements for Diluting and Flushing Double-Shelled Tank Systems.*

RPP-6598 Rev 0, *Reliability, Availability, Maintainability Analysis of the 230 kV Hanford Site Transmission System.*

Attachment F

Attachment F

Optimize the Caustic Diluent Pad Design to Minimize the Accumulation of Water

OPTIMIZE THE CAUSTIC DILUENT PAD DESIGN TO MINIMIZE THE ACCUMULATION OF WATER

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Release 46
Report No. 990920203-020
ACDR Subtask 6
Revision 0

September 2000

prepared by

HND TEAM

OPTIMIZE THE CAUSTIC DILUENT PAD DESIGN TO MINIMIZE THE ACCUMULATION OF WATER

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Release 46
Report No. 990920203-020
ACDR Subtask 6
Revision 0

September 2000

Prepared by: Chip Conselman, P.E.

Approved by: RLFritz
Robert L. Fritz

Date: 9-29-00

Table of Contents

Tables

Acronyms

ACD	Advanced Conceptual Design
DST	Double-Shell Tank
HLW	High-Level Waste
LAW	Low Activity Waste
RPP	River Protection Project
WTF	Waste Treatment Facility

1.0 INTRODUCTION

Project W-521, Waste Feed Delivery Systems, is installing a diluent and flush system at both the SY farm in the 200 West Area and the AW farm in the 200 East Area. These systems will supply treated water for in-tank and in-line dilution, pipe pre-heating, and line flushing for low activity waste (LAW) and high-level waste (HLW) transfers including intra-farm transfers, inter-farm transfers, and transfers to the Waste Treatment Facility (WTF). The major components of these systems consist of chemical tanker offload equipment, a packaged water heater with associated support equipment, metering pumps for chemical injection, a static mixing tee, a mixing and storage tank, supply pumps, valves, piping, and instrumentation used for monitoring and control.

During the conceptual design phase of the project, various questions and concerns were raised about the capabilities and layout of these two systems. Also, since preparation of the CDR, numerous changes have been made to the requirements contained in the Level 2 specification, HNF-4163, *Double-Shell Tank Diluent and Flush Subsystem Specification*. In order to address all of these items, several tasks were undertaken as part of the Advanced Conceptual Design (ACD) effort. These included: 1) comparing using fuel oil versus an electric water heating system, see, *Comparison of Fuel Oil Boiler to Electric Heating System for Project W-521, Diluent Supply*, Rev. 0, Report 990920203-012;) optimizing the pad design to minimize accumulation of water and 3) refining the diluent system piping tie-ins.

1.1 Purpose

The purpose of this task was to optimize the design for the diluent and flush system containment area, through minimizing the accumulation of water. The DST diluent and flush system containment structure provides four primary functions:

- Shelters the components and equipment from harmful elements of the weather,
- Provides containment for bulk chemicals,
- Provides a space for the components and equipment in one concise area, and
- Provides safety shower and eyewash stations at the diluent and flush stations.

1.2 Scope

The main focus of this task was to refine the design for the diluent and flush system containment area to 1) minimize the accumulation of water and debris within the sump and 2) provide for easy removal of these items from the containment area. This will allow the system to function in a manner which minimizes operation involvement, and also minimizes the unnecessary generation of waste.

2.0 METHODOLOGY

The design for both the SY farm and AW farm diluent and flush systems was reviewed, looking for ways to improve the layout and function of the system with the primary focus on the containment structure. This effort was coordinated with another task being performed during the W-521 ACD effort, which involved comparing the use of fuel oil versus an electric water heating system for the diluent and flush system. The revised requirements from the Level 2 Specification were also incorporated.

Alternatives that were considered included:

- Modifications to the design of the containment structure and drains,
- Use of a roof over the containment area, and
- Incorporation of various waste removal systems.

3.0 ASSUMPTIONS

The diluent and flush system at SY farm will utilize an electric water heating system and will have a 20,000 gallon flush tank (see conclusions of *Comparison of Fuel Oil Boiler to Electric Heating System - Project W-521, Diluent Supply*, Rev. 0, Report 990920203-012).

The diluent and flush system at AW farm will utilize an electric water heating system and will have a 10,000 gallon flush tank (see conclusions of *Comparison of Fuel Oil Boiler to Electric Heating System - Project W-521, Diluent Supply*, Rev. 0, Report 990920203-012).

The requirements in the Level 2 Specification will be waived or modified as discussed in the references above.

4.0 DISCUSSION

The majority of the requirements imposed upon the design of the diluent and flush system are contained in HNF-4163, *Double-Shell Tank Diluent and Flush Subsystem Specification.* The ones that have potential impact on the layout and design of the containment area are shown in Table 4-1.

Table 4-1. HNF-4163 Requirements.

REQUIREMENT	HNF-4163 SECTION
1. The Diluent and Flush Subsystem shall use concentrated commercial-grade sodium hydroxide (commonly referred to as caustic soda) at a concentration of up to 50 wt % provided by the Double-Shell Tank (DST) Maintenance and Recovery Subsystem.	3.1.2.1.5.a 3.2.5.2.1.a
2. The Diluent and Flush Subsystem shall use concentrated commercial-grade 40 wt % sodium nitrite ($NaNO_2$) provided by the DST Maintenance and Recovery Subsystem.	3.1.2.1.5.b 3.2.5.2.1.b
3. The DST Diluent and Flush Subsystem shall be capable of unloading the chemicals identified in Section 3.1.2.1.5.	3.2.1.1.g
4. The Diluent and Flush Station (containing piping, tanks, pumps, etc.) shall have adequate containment for unmitigated leaks or spills.	3.3.6.b
5. The DST Diluent and Flush Subsystem shall be designed to keep personnel exposure as low as reasonably achievable (ALARA) in accordance with RPP-PRO-1621 and RPP-PRO-1622.	3.3.6.1.b
6. The DST Diluent and Flush Subsystem shall incorporate occupational safety and health design features that comply with the requirements of *Tank Farms Health and Safety Plan*, HNF-SD-WM-HSP-002 and DOE Order 6430.1A.	3.3.6.1.a
7. Safety shower and eyewash stations shall be provided at the Diluent and Flush stations and shall comply with *Emergency Eyewash and Shower Equipment*, ANSI Z358.1.	3.3.6.1.c
8. The containment skid shall be resistive to pressure gradients above and below the foundation and shall be capable of preventing failure caused by settlement, compression, or uplift.	3.2.5.1.c
9. The subsystem shall be designed for the natural environmental conditions specified in *Natural Phenomena Hazards, Hanford Site, Washington*, HNF-SD-GN-ER-501.	3.2.5.1.a
10. The subsystem shall be designed to withstand the natural phenomena hazards as specified in *Engineering Design and Evaluation*, RPP-PRO-097.	3.2.5.1.b
11. All concrete work shall meet the applicable design and construction requirements contained in *Building Code Requirements for Reinforced Concrete*, ACI 318.	3.3.1.c
12. The DST Diluent and Flush Subsystem shall comply with *General Design Criteria*, DOE Order 6430.1A, Sections 1300-7 and 1323.	3.3
13. The DST Diluent and Flush Subsystem shall be designed for positive removal (such as a locked drainage valve) of contaminated liquids and uncontaminated precipitation.	3.3.1.j
14. The DST Diluent and Flush Subsystem shall comply with "Carriage by Public Highway," "General," Title 49 CFR 177.834, parts (I)(2)-(5), during tanker unloading.	3.3.1.1

The key requirements in Table 4-1 that affect the layout of the containment system are 3, 4, 12, 13 and 14. These items were focused on for refining the containment system design.

4.1 Requirement 3

Requirement 3 states that "The DST Diluent and Flush Subsystem shall be capable of unloading the chemicals identified in Section 3.1.2.1.5." Based upon the change from oil fired heaters to electric heaters, the revised layouts optimize the load-in connections, located within the containment structure. This revised layout also optimizing space for truck access, as well as operator accessibility.

4.2 Requirement 4

Requirement 4 states that "The Diluent and Flush Station (containing piping, tanks, pumps, etc.) shall have adequate containment for unmitigated leaks or spills." The CDR provided general containment without specific requirements. In discussions with CHG personnel, it was decided to use WAC-173-303, Chapter 630, to size the containment structure for the tank storage area and provide "adequate containment". This will provide sufficient capacity for 100 percent of the volume of the largest container, plus the additional volume that would result from the 25-year storm of 24-hours duration (1.59-in.). The revised design incorporates this criteria, utilizing the assumptions given in Section 3.0 for tank sizes, as well as the considerations of electrical heaters.

No specific containment requirements exist for the truck/ chemical unloading areas, which will consist of concrete slabs with approximately 4-in. high curbs. These slabs will slope to a drain that drains into the containment structure for the tank storage area.

4.3 Requirement 12

Requirement 12 states that "The DST Diluent and Flush Subsystem shall comply with *General Design Criteria,* DOE Order 6430.1A, Sections 1300-7 and 1323." These sections deal mainly with confinement and collection systems. The detail required by this requirement will be addressed during the definitive design, however, the revised design includes the proper layouts and sufficient capacity to meet these requirements.

4.4 Requirement 13

Requirement 13 states that "The DST Diluent and Flush Subsystem shall be designed for positive removal (such as a locked drainage valve) of contaminated liquids and uncontaminated precipitation." The revised design complies with this requirement through use of a containment basin which drains into a sump. This provides an easily accessible location to remove contaminated liquids and uncontaminated precipitation.

4.5 Requirement 14

Requirement 14 states that "The DST Diluent and Flush Subsystem shall comply with "Carriage by Public Highway," "General," Title 49 CFR 177.834, parts (I)(2)-(5), during tanker unloading." The key design requirement obtained from this document is that the "the qualified person attending the unloading of a cargo tank must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable during the unloading operation." The revised layout of these systems optimizes operator access which supports this requirement.

4.6 General

The CDR for Project W-521 assumed using the containment sump at Tank 302-C and the containment slab installed by W-058 as part of the 241-SY diluent and flush containment system. After performing further reviews of this layout, it was decided to not utilize the Tank 302-C sump, as this plan would spread any spills into the Tank 302-C containment basin and require additional, unnecessary cleanup efforts. The revised layout still utilizes the W-058 slab for supporting pumps and heaters. This slab would also drain into the W-521 provided containment structure.

The current W-521 diluent and flush system design employs a raw water strainer with an automatic back-flushing feature. This routine back-flush water is discharged into the containment sump. Removing this automatic back-flushing condition by using a manual "duplex" type strainer will help minimize the amount of water discharged into the sump.

Consideration was also given to constructing a roof structure over the new containment areas, as well as the existing W-058 slab area at SY farm. This would help minimize the accumulation of unwanted debris and rainwater within the containment structure sump. It would also reduce the weather exposure received by the diluent and flush system equipment. This consideration was considered appropriate and is incorporated into the revised drawings.

The overall initial cost of this option is expected to increase by $417,842 from the conceptual estimate (see Table 4-2). This initial increase is primarily due to the addition of a roof structure, as all other optimization efforts resulted in minimal increases or decreases.

Table 4-2. Cost

DILUENT SYSTEM MODIFICATIONS - ADD TO CDR ESTIMATE												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
$185,420	$2,017	$64,417	$5,271	$7,027	$3,514	$1,757	$5,271	$3,514	$47,891	$51,486	$40,257	$417,842

The addition of a roof is, however, considered appropriate from an equipment reliability perspective, a waste generation perspective, and a life-cycle operations perspective.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed layout for the 241-SY diluent and flush system is shown on ESW-521-M16. The proposed layout for the 241-AW diluent and flush system is shown on ESW-521-M12. Both systems include a roof structure over the containment areas to shelter the system components from the weather and to minimize the accumulation of rainwater and debris within the sump. The sumps are located where they can be easily accessed for cleaning and pumping out of accumulated liquids. A manual duplex type strainer was used for back-flushing.

The 241-AW system will be located west of the AW farm, outside the farm fence and within the old Purex exclusion zone. This location has been selected based on proximity to the AW valve pits and the space available for the water heater package, storage tank, pumping and instrument enclosures, and chemical off-load equipment.

The 241-SY system will be located northwest of the SY farm, near the Tank 302-C containment structure. It will make use of a portion of the existing system installed by Project W-058.

6.0 REFERENCES

HNF-4163, *Double-Shell Tank Diluent and Flush Subsystem Specification.*

WAC-173-303, Chapter 630, *Washington Administrative Code Dangerous Waste Regulations.*

Attachment G

Attachment G

Mixer Pump Analysis to Support Procurement Specification Preparation

MIXER PUMP ANALYSIS TO SUPPORT PROCUREMENT SPECIFICATION PREPARATION

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Release 46
Report No. 990920203-018
ACDR Subtask 7
Revision 0

September 2000

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Prepared by: Steve Riesenweber
Phillip J. Brackenbury, P.E.
Kristyn Clayton

Approved by: ______________________
Robert L. Fritz

Date: ______________________

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Acronyms

BHP	Brake Horsepower
CDR	Conceptual Design Report
DST	Double Shell Tank
ECR	Effective Cleaning Radius
HLW	High-Level Waste
HWVP	Hanford Waste Vitrification Project
ID	Inside Diameter
NCAW	Neutralized Current Acid Waste
NPSHA	Net Positive Suction Head Available
NPSHR	Net Positive Suction Head Required
PDC	Project Definition Criteria
PNNL	Pacific Northwest National Laboratory
SRS	Savannah River Site
SST	Single-Shell Tank
WRSS	Waste Retrieval Sluicing System
WVDP	West Valley Demonstration Project

1.0 INTRODUCTION

1.1 Purpose

The purpose of this task is to address the issues affecting the baseline design for mixer pumps procured by W-521 and provide basis for any changes to the technical or cost baselines established in the CDR.

This evaluation will propose an optimum size, number and arrangement of mixer pumps in the eight Project tanks while minimizing Project costs.

1.2 Scope

Certain criteria and critical parameters associated with the Project W-521 procurement specification for mixer pumps were evaluated. The current Project W-521 baseline design concept is four 150 hp mixer pumps per tank for double-shell tanks (DSTs) AY-101 and AY-102, and two 300 hp mixer pumps per tank for the balance of the DSTs in the Project (SY-101, SY-102 and SY-103, AW-101, AW-103 and AW-104).

This evaluation's key objectives were to:

- Verify the minimum requirements related to performance and physical and environmental characteristics;
- Ensure the applicability of the mixer pump baseline concept to the DSTs in the scope of Project W-521;
- Provide an overview of the experience gained and lessons learned from computer modeling and similar past tank mixing results at the principal sites;
- Examine the origin of the effective cleaning radius (ECR) determination technique to ensure the applicability holds for the situations encountered in the DSTs within Project W-521;
- Determine if the proposed CDR pump arrangement is optimal;
- Examine the feasibility and advisability of providing two reduced dimension (outer diameter) 300 hp mixer pumps for the AY tanks; and
- Make recommendations on changes to the procurement specification and drawings, and suggested follow-up project activities which result from the results of the above evaluations.

There are four 34-in. inside diameter (ID) risers in each AY DST located equally spaced on a 22-foot radius (with respect to the tank center). The implication has been that the per-tank mixing effectiveness of four 150-hp pumps will equate to a mixing power equivalent of two 300-hp pumps. A principal driver for conducting this evaluation was to determine whether lower horsepower mixer pumps or a fewer number of mixer pumps can be utilized to effectively mix the Project W-521 tank waste. The concern originates with the inability to insert the available (baseline) 300 hp mixer pumps which require a 42-in. ID riser into the 34-in. ID risers of the 241-AY DSTs. The 300-hp mixers were developed for Project W-151, and will be used by companion Project W-211 in the 42-in. ID DST risers.

There is an emergent additional concern. Project W-523 is tasked with sluicing the contents of single shell tank (SST) 241-C-104 (C-104) into DST 241-AY-101 (AY-101), preferably through an existing sluice pit in AY-101. In this scenario, a transfer pump installed by Project W-521 would supply supernatant waste from the central pump pit to a booster pump installed in the AY-101 01E sluice pit then transfer the supernatant to the sluice nozzle(s) in C-104. Provisions would also be made at 01E to receive the material sluiced from C-104. If Project W-523 cannot access an existing sluice pit, a new pit, and associated equipment, may be required (estimated cost of $3-5 million).

If deprived of one of the available sluice pits, Project W-521 would then have to mix the contents of AY-101 either with three small asymmetrically located 150 hp pumps, or with two 300 hp pumps located symmetrically opposed. A 150 hp mixer design compatible with 34-in. risers is available and is the standard at the Savannah River Site (SRS). Currently, a 300 hp mixer design compatible with 34-in. risers is not available.

2.0 METHODOLOGY

The process followed in the conduct of this work included the following activities:

- a historical review of pertinent existing literature and comparative experience was performed,
- identification of specification issues associated with mixer pump technology was made,
- the formulation of a technique which permits correlation of the ECR and pump brake horsepower (BHP) required, and was prepared,
- contacts with vendors with recent experience in the fabrication of mixer pumps with potential application to the Project were made.

A brief description of each of these activities follows.

2.1 Historical Review

Records about mixer pump development and deployment into the field are rich with documentation applicable to the topic of the Project W-521 mixer procurement specification. The available references span the range of test reports describing the development effort, sample analysis campaigns and results, modeling results reports and bibliographies containing comprehensive lists of applicable documentation. In addition, the preliminary results of the Project W-151 initial full-scale test were evaluated for potential impacts to Project W-521.

Sluicing a tank is a process of exposing the settled material, mobilizing the settled material with jets of liquid, and then pumping out the mixed fraction to a second receiver. Often the second receiver provides the source of the sluicing or mobilizing liquid. This process is repeated, removing the mixed fraction to expose the unmixed portion, mobilizing the unmixed portion until well mixed, removing the mixed fraction and so on.

Mixer pumps mobilize the material using the resident liquid fraction, or that portion which is pumpable, through oscillating high velocity, submerged jets. Once mobilized the material is transferred to a second receiver with a transfer pump. There may be multiple mixer pumps and each may utilize single or multiple jets from each volute. Although a single jet mixer pump could exist, it is advantageous to oppose multiple jets to offset hydraulic forces the jets create on the mixer pump column. This is the configuration required by Shaw 2000a "*Net Positive Suction Head Available Analysis for Phase 1 Waste Tanks.*"

The focus on and preference for mixer pumps may well have originated at the SRS, where there is a very high water table and where, in the 1970s, there was a developing concern for the long term integrity of their storage tanks. The goal at that time was to move both salt and sludge waste from tanks with suspect long-term integrity to newer type double shell tanks. Based on their own testing and experience, long shaft centrifugal pumps were selected to mix the waste in preparation for the transfers. Mixer pumps would not add water and consequently would minimize the risk to the environment.

The same is true at Hanford. While mobilization using liquid jets (sluicing) has been successfully demonstrated (most recently reported in Bailey 2000, "Waste Retrieval Sluicing System (WRSS) and Project W-320. Tank 241-CV-106 Sluicing Lessons Learned"), mixer pump technology has been retained as the method of choice.

2.2 CDR Preliminary Procurement Specification Review

Project W-521 used as its early baseline for mixer pumps the baseline in place for Project W-211. In continuing the development of the baseline for Project W-521 it was considered appropriate to compare the scope of the project to the new requirements for mixer pumps which have only recently been approved in the Level 2 Specification (Shaw 2000b). The requirements for mixer pumps applied by Project W-211 evolved somewhat differently, having their origin within the functional requirements for the Project W-151 mixer pump performance demonstration on tank AZ-101. The question the design team attempted to answer is "Do the new requirements fit well within the scope of Project W-521 and within the originally assumed context of the W-211 requirements?"

The minimum requirements related to performance, physical, and environmental characteristics are contained within the mixer pump Level 2 specification (Shaw 2000b). This task has concentrated on the applicability to Project W-521 of the foregoing specified characteristics.

2.3 Analytical Correlations

The baseline from the *Project Definition Criteria for Project W-521, Waste Feed Delivery Systems* (Weaver 1999) for mixing the contents of the AY tanks is four 150 hp mixer pumps. The Savannah River site has experience with 150 hp mixers in 20 weight percent sludges producing ECRs of 25 ft. The primary Hanford experience, that relates to Project W-521, with producing ECRs in resident sludges is with two 300 hp mixer pumps (Project W-151). These pumps were designed for installation into 42 inch risers. They will not fit in the 34-in. risers available in AY tanks. The Project Definition Criteria (PDC) assumed that four 150 hp pumps, having the same total horsepower as two 300 hp pumps, would provide equivalent mixing. Two alternative correlations are derived in this evaluation to verify this assumption. These are:

- Estimate the ECR that can be expected in Hanford sludges at the reduced (150) horsepower, and
- Estimate the brake horsepower needed to achieve a given ECR.

A review of modeling techniques by Pacific Northwest National Laboratories (PNNL) has also been included in this report for derivation of the equations used in the analysis.

2.4 Vendor Contacts

To determine the feasibility of obtaining a mixer pump that will fit the 34 inch risers and be capable of an ECR that will sweep the entire tank, discussions were held with both Sulzer Bingham Pumps, Inc. (Sulzer) and Lawrence Pumps, Inc. (Lawrence). Tank elevation and plan views were forwarded to both Sulzer and Lawrence for their use in developing the concept. Additional information applicable to the characteristics of the tank contents was also compiled and forwarded for their use. After their review, a meeting with Sulzer personnel was conducted at ARES to discuss their findings and the potential options (Brackenbury 2000, "*W-521 Advanced Conceptual Design Report-Reduced Diameter Mixer Pump Concept for 34-in. ID Risers*"). The Lawrence contacts were conducted in a series of telephone interviews.

3.0 DISCUSSION

3.1 Mixer Pump Historical Review

The subject of mixing tank waste has been studied by the operators of the government nuclear complex for decades and reported on in depth (e.g. Shaw 1992, Waters 1994 and Powell 1997). The applicable literature contains examples of studies and experimental result reports applicable to nearly every conceivable method of agitation.

Sluice jets (free jets or "past practice" technology) and mixer pumps (submerged jets) have generally been the method of choice to mobilize tank waste.

3.2 Sluicing Versus Mixing

Sluicers add water to the tank inventory (sometimes reported as high as 16:1), process sludge slowly, require close coordination of sluicer streams to hit the sludge from different angles, are prone to failure at their flexibility locations, bring with them process complications, and must be coupled with an adjacent tank to provide a destination for mobilized wastes. Mixer pumps are self-contained in that they must only be installed and energized. Because they generally mobilize the sludge faster and bring with them reduced risk, mixer pumps have become the preferred method when the schedule permits.

At Hanford the concept of two 300 hp mixer pumps was formulated in support of the preparatory activities for the Hanford Waste Vitrification Project (HWVP). Early planning called for the mixing of the neutralized current acid waste (NCAW) contents of 241-AZ-101 (AZ-101), batching this material through 241-AR vault, forwarding the batches to B Plant for pretreatment, and then passing a portion of the pretreated waste on to HWVP for vitrification. A functional design criteria for installing and demonstrating a mixing system in AZ-101 and conducting a "retrieval system process test," was completed in 1989. The specified equipment for this process test was two 300 hp mixer pumps and instrumentation to monitor the pumps' performance and effectiveness. The goal of the process test was to achieve 90 percent mobilization of the contents of AZ-101. This performance goal was based on the modeled performance of a two-pump system used by the PNNL in 1/12th scale studies.

Lack of sludge characterization data continues as the greatest obstacle in predicting the effectiveness of a multiple pump mixer system. A correlation between mixer pump jet conditions and sludge shear characteristics has been developed and demonstrated through scale testing. Preliminary evaluation of recent full-scale test results appears to confirm correlations. However, detailed analysis remains to be performed.

3.3 Comparative Experience

3.3.1 Project W-151, Tank AZ-101 Process Test

Successful field demonstration has the ability to be much more convincing than modeling or analysis. With the apparent successful completion of the process testing of the two 300 hp mixer pumps in AZ-101 reported in Carlson 2000, "*Preliminary Test Report, 241-AZ-101 Mixer Pump Test,*" some ability to corroborate previous modeling and analysis has become possible.

U_oD is the product of the velocity of the mixer pump jet in ft/sec and the diameter of the jet in feet, and is how the size or power of a jet is characterized. The U_oD of the AZ-101 mixer pumps at rated speed is 29.4 ft^2/s and the ECR achieved was 37.4 ft. The ECR was determined by monitoring changes in the temperature in the waste and in the insulating concrete under the tank bottom. Preliminary evaluation of measurements during the testing indicates the mixer pumps were successful in mobilizing settled solids from at least 95 percent of the tank bottom and could maintain solids in suspension while operating.

The AZ-101 process test is not necessarily representative of results that can be expected when mixing the deep sludges most problematical to Project W-521. Sludge depth at test conditions was shallow, on the order of 1.5 ft., unlike conditions in the AY tanks, and the mixer pump nozzle location was placed at or just above the liquid/sludge interface. Both of these circumstances are nearly ideal to achieve success. In addition, the discharge jet and the waste disturbed during the operation of the pumps was not able to be observed to determine their behavior, especially at the extremes of effectiveness, the regions of most interest. The fact remains, however, that this test comprises the bulk of available Hanford field data and decisions concerning the specified U_oD and expected ECR are promising, but not conclusive.

3.3.2 Savannah River Site

Mixer pump testing has been conducted at SRS since the mid-1970s, beginning first with tests in a half-tank mockup. A shallow, one-half section of a full tank was used to demonstrate the mixing effectiveness of slurry simulants composed of kaolin and water. A 150 hp mixer pump was operated for a specified time and the liquid component of the mixture was then removed to reveal the unaffected simulant. The distance from the mixer pump nozzle exit to the base of the unaffected material (the ECR) was then measured. These half tank tests indicated that the ECR is directly proportional to the product of the jet velocity at the nozzle exit and the nozzle diameter (U_oD). It was also determined that the proportionality constant for the equation was dependent on the properties of the sludge simulant.

Based on the tests conducted in the half tank it was concluded that these 150 hp pumps (U_oD of ~12.75 ft^2/s) would produce an ECR of 20 ft. in the waste tanks at SRS. Half tank testing led SRS to predict that 85 percent of the waste could be removed using five such pumps. In actual practice the tank was cleaned to a 98 percent condition using just three such pumps. This result indicated that further definition of the cleaning mechanism was required; but that effective waste mobilization is possible with smaller mixer pumps.

The results also seemed to confirm the proportionality between the ECR and the U_oD observed in the half tank tests, although the proportionality constant was different. It has been speculated by researchers that the difference is likely due to the difference in the waste characteristics. Project W-521 can expect that waste characteristics will have similar effects on mixer pump ECRs as well.

3.3.3 Oak Ridge National Laboratory (ORNL)

In preparation for mixing and then removing the contents of the Melton Valley Storage Tanks, testing was conducted on scale models of the 60 ft. long 12 ft. diameter horizontal cylindrical tanks. Submerged sluicing jets were used (Hylton, et al. 1995). The physical configuration was markedly different and the waste simulant employed had considerably less yield stress than what is anticipated at Hanford, therefore the results are considered not comparable to testing or analytical results at either SRS or Hanford.

3.3.4 West Valley Demonstration Project

At the start of their cleanout campaign, West Valley Demonstration Project (WVDP) had one tank containing sludge material. This site has since mobilized the sludge, emptied the tank, and vitrified the material. In preparation for this task, scaled mixer pump testing was conducted in a 1/6 scale mockup to determine the number of mixer pumps that would be required. The simulant utilized was formulated of kaolin and water with a shear strength similar to that measured in the actual tank. Testing seemed to indicate that as many as five mixer pumps would be required to mix the contents (Schiffauer, et al. 1985) primarily to ensure that all the sludge could be accessed by the mixer pump jets.

WVDP did not report on the correlation between the measured ECR and the mixer pump U_oD. The speculation is that obstructions present in the tank (columns between floor and ceiling, and gridwork on the floor) were potentially more limiting to the success of the mobilization effort than the effectiveness of the energy created by the jet described by it's U_oD. That the correlation was not reported is unfortunate because of the similarity the obstructions located in the WVDP tank have with obstructions located in AY-101 and 102.

3.4 Summary of Key Mixer Pump Parameters

A comparison of key mixer pump parameters demonstrated in actual field operations is provided in Table 3-1.

Table 3-1. Mixer Pump Comparison.

	SRS		Hanford			
	Tk 16H	Quad.	(AZ-101)	INEEL	ORNL	WVDP
Capacity (gpm)	1200	4000	10,400	No Data	Not applicable. These tanks have dissimilar arrangement.	No Data
Nozz. Dia. (in.)	2 @1 ½	4 @ 3	2 @ 6			
Speed (rpm)	1760	2200	1200			
Motor Horsepower	150	300	300			
U_oD (ft^2/s) (1)	12.75	~20	29.4			
ECR (ft.)	25(2)	40(2)	37.4(3)			

Notes:
(1). Nozzle discharge coefficient
(2). In 20 weight percent slurry
(3). In 18 lb/ft^2 sludge

3.5 W-521 Level 2 Specification Issues

The specification issues addressed are the performance characteristics required to mobilize, suspend, mix, blend and homogenize the Project W-521 tank wastes. The physical characteristics of interest relate primarily to the ability to fit pumps which satisfy the specified performance criteria into the reduced diameter risers of tanks AY-101 and AY-102. The environmental issues of concern are the net positive suction head available and the in-tank temperature range as they relate to pump operations.

3.5.1 Performance Requirement Issues

Following is a discussion of the Level 2 specified requirements for mixer pumps and the concerns which arose from the specification.

3.5.1.1 Jet Configuration and Characteristics

Submerged liquid jets (mixer pumps) are the preferred method for accomplishing the specified waste preparations. Testing has shown that the ECR is directly proportional to the nozzle velocity times the jet diameter (U_oD). Scale testing supports the specification of twin jets operating 180 degrees opposed with a U_oD value of 29.4 ft^2/s as being effective on Hanford sludges of 10 $kdynes/cm^2$, a conservative value. This has recently been successfully demonstrated during the full scale AZ-101 mixing process verification.

The Level 2 specification stipulates a U_0D value of 29.4 ft^2/s for pumps. The requirement implies that meeting this parameter will result in an ECR that will mix the tank contents to a homogeneous mixture (another requirement of the Level 2 Specification). However, the Level 2 Specification, and some of the other literature on mixing effectiveness, does not address the fact that the nozzle shape and characteristics of the flow stream leaving the nozzle are critical parameters in maximizing the ECR. One study mentions that an improperly shaped nozzle can reduce the ECR by as much as 50 percent; however the study does not establish what constitutes a properly shaped nozzle.

Nozzle designs can be varied to produce discharges that range from highly focused flow that has a great degree of momentum in a direction axial to the discharge (such as might be used for long distance fire fighting) to a flow that diverges immediately upon exiting (such as can be seen in some types of sprinklers). Maximization of the ECR means achievement, to the highest degree possible, of the focused flow. An Optimal configuration is a jet discharge that is straight, only slowly diverging, and non-swirling while maintaining a U_oD of at least 29.4 ft^2/sec.

The problem is compounded by the fact that accommodating the prescribed U_0D value necessitates a relatively large diameter pump. Due to this, mixer pumps that have typically been used at Savannah River and Hanford are configured with a nozzle that is little more than an orifice plate. Standard nozzle design would configure a nozzle with a length that is several times longer than the nozzle discharge diameter. Since the typical nozzle has a diameter of 6 inches, that two opposing nozzles back-to-back could fill an entire 42-in. riser leaving no room for the pump. In lieu of having optimal nozzle length, two primary parameters remain to be optimized:

1. The shape of the orifice nozzle bore is important to the pressure drop across the orifice as well as the flow characteristics of the discharge. This should be addressed in definitive design either by specifying an orifice shape in the pump procurement specification or by requiring the pump manufacturer to make a nozzle that meets particular flow characteristic or momentum requirements.

2. The pump casing shape and flow characteristics should be optimized because they can have a significant effect on the characteristics of the flow discharging from an orifice-type nozzle. High levels of turbulence in the casing/volute will exacerbate the diverging discharge problem (and reduced ECR) discussed previously.

3. Commission PNNL to extend the correlation that established U_0D to include definition of nozzle jet flow characteristics needed to achieve the desired ECR.

4. Commission a pump company (i.e. Sulzer, WEMD, or Lawrence) to develop concepts and establish parameters for optimization of the pump casing/volute to generate the best possible jet flow.

5. Revise the mixer pump procurement specification to specify the characteristics resulting from items 1 and 2, above.

3.5.2 Net Positive Suction Head Available (NPSHA) vs. Required (NPSHR)

- The Net Positive Suction Head Available (NPSHA) is to be derived from RPP-5585 Shaw 2000a, "*Net Positive Suction Head Available Analysis for Phase 1 Waste Tanks.*"
- The waste temperature is specified as 50 – 220°F.
- The pump is to be capable of pumping with only 3 ft of submergence.

With this criteria, RPP-5585 shows that at 220 F the NPSHA is less than 10 ft. At full speed, where the specified U_0D is achieved, mixer pumps are expected to have Net Positive Suction Head Required (NPSHR) of approximately 24 ft. or greater (see Attachment A for a discussion of this assumption). Fundamentals of physics and pump technology make it clear that these two requirement extremes (3 ft. and 220 F) cannot exist at the same time. Per RPP-5585 (Shaw 2000a), the high vapor pressure associated with elevated waste temperatures dramatically reduce the NPSHA. At 212 F with only 3 ft. of submergence the resulting NPSHA is approximately 6 ft. This difference between available and required net positive suction head would create excessive cavitation in pumps. It should be noted that high cavitation would only occur when the tank level is fairly low (a small percentage of the time) since at higher tank levels the head of waste above the pump suction would increase the NPSHA.

The 3 ft. submergence requirement, with the high flow rate required (approximately 10,400 gpm with a 6-in. nozzle) creates a high potential for vortexing at the pump suction. Air entrainment resulting from vortexing can be harmful to pump components and can diminish pump performance.

To resolve the issues associated with NPSHA and waste temperature, the actions described below are recommended.

- An estimate should be made of the amount of time that a mixer pump could be required to operate with an NPSHA less than the NPSHR.

- Pumps should be designed to have gradually degrading discharge head characteristics during conditions where NPSHA is less than NPSHR. The pump procurement specification should combine this cavitation response with the requirement that the pump be robustly designed to achieve design life with intermittent periods of cavitation.

- Pumps should be designed for "low" NPSHR by opening up the impeller eye, and other actions. However, this can cause problems in terms of pump vibration if the actual NPSHA is much higher than that specified. Thus, an evaluation should be performed to determine the "most reasonable" NPSHA value to supply to the pump manufacturer. This should be done in conjunction with the above mentioned items.

- The possibility of slowing the pump down during low tank levels should be evaluated. This action should be possible since initial tank mixing is expected to require considerably more energy than maintaining homogeneity of the waste mixture. It is only during the final stages of tank transfers (after the contents have been mixed) that the lowest NPSHA is expected.

- The pump specification should be modified to require the design to address vortexing.

3.5.3 Physical Characteristic Issues

The Level 2 Specification acknowledges the requirement for installing reduced diameter mixer pumps in that it requires designs capable of installation in both 42-in. and 34-in. diameter risers. The maximum diameter of components below the mounting flange for pumps installed in 34-in. risers is specified as 31-in. The Project W-521 PDC stipulated that in each AY tank, four 150 hp pumps would be installed—one each in each of the 34-in. sluice risers.

The feasibility of procuring a 300 hp pump with a U_0D value of 29.4 ft^2/s that would fit in a 34-in. riser was assessed. This evaluation concluded that several significant benefits exist if two 300 hp pumps can be used in the AY tanks. Examples include:

- Cost savings to Project W-523 that was proposing to install a new pit on tank AY-101 for slurry return from tank C-104 sluicing activities instead of using one of the sluice pits,

- Project W-521 costs will be reduced by eliminating the procurement and installation of four mixer pumps (two for each tank) including indexing devices, water supplies, monitoring and control,

- Project W-521 costs will be reduced by eliminating the need to remove and dispose of one transfer pump and one booster pump from an AY-102 sluice pit, and

- Operations will be simplified and standardized by consistently using a two pump arrangement.

Through discussions with pump vendors, a high level of confidence was gained that 300 hp pumps that will fit through a 34-in. riser can be supplied with the 29.4 ft^2/s U_0D value desired (see Section 3.7).

Early in definitive design, it is recommended that a pump company be commissioned to build a working model of a 31-in. diameter pump unit. The following actions are recommended to verify the feasibility of providing a reduced diameter 300 hp mixer pump:

- Verify the smaller diameter design concept,
- Establish NPSH requirements and pump head degradation characteristics,
- Develop concepts and establish procurement specification parameters for optimization of the pump casing/volute to generate the best possible jet flow, and
- Test pump suction configurations to minimize vortexing at low tank levels. This can help establish operating parameters for all mixer pumps.

Results of this feasibility evaluation should be incorporated into the mixer pump procurement specification.

3.6 Analytical Correlation

3.6.1 TEMPEST Modeling

The TEMPEST code is a three-dimensional time dependant code that simulates flow, mass and heat transfer, and chemical reactions analyzed simultaneously. The code has previously been applied to Hanford double shell tanks AP-102, SY-101 and SY- 102, AZ-101, AY-102 and C-106 to model tank waste mixing with rotating jets, gas rollovers and waste transfers from one tank to another (Onishi 1999 and Whyatt 1996). In this work, TEMPEST permitted the accurate prediction of waste behavior under the effects of various mixer pump horsepower.

PNNL recently completed a study in which the contents of 241-AN-105 (to be transferred to 241-AP-102/104) were modeled to determine the effectiveness of a single central pump in mixing its soluble contents. Several cases were studied, with various dilution, dissolution and initial conditions assumed. The results are reported in Onishi 1998. The model results indicate that a 300 hp pump with rotating 6-in. diameter, 60 ft/s jets (U_0D equals 30 ft^2/s) centrally located in 241-AP-102/104 can suspend the slurry and keep it in suspension within at least 94 percent uniformity over the entire tank.

It should not be assumed that all tanks will experience the same mixing effectiveness. Such factors as material shear stress, waste depth, and pump nozzle design can dramatically impact tank mixing. Thus, the collection of improved waste rheology data will provide improved confidence in the model results that are used for waste retrieval planning.

3.6.2 Determination of ECR Required in Tanks AY-101 and AY-102

The minimum ECR required for a 75 ft. diameter tank using four pumps is approximately 27 ft. as shown in Figure 3-1 and defined by the tangential point at the tank inside for the cleaning radii. The horsepower required to achieve this ECR is dependant on the shear strength of the resident sludge and is calculated in Section 3.6.3.

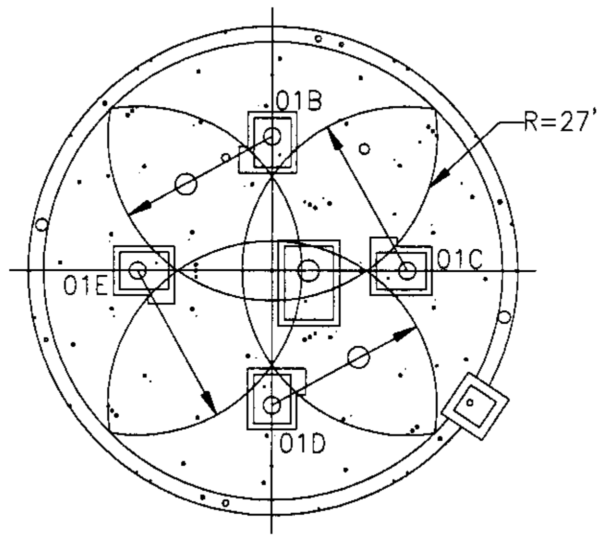

Figure 3-1. Four Pump Combination Effective Cleaning Radius.

With the potential loss of one sluice pit (01E) from tank AY-101 to Project W-523 the possibility of utilizing only three mixer pumps was investigated and is shown in Figure 3-2. Note that when there are three pumps in sluice pits located on tank quadrants, the two mixers offset/opposed at 180 degrees must cover the entire tank. The third pump does little to assist in reaching the area under sluice pit 01E. A minimum ECR required of the three pumps is 44 ft.

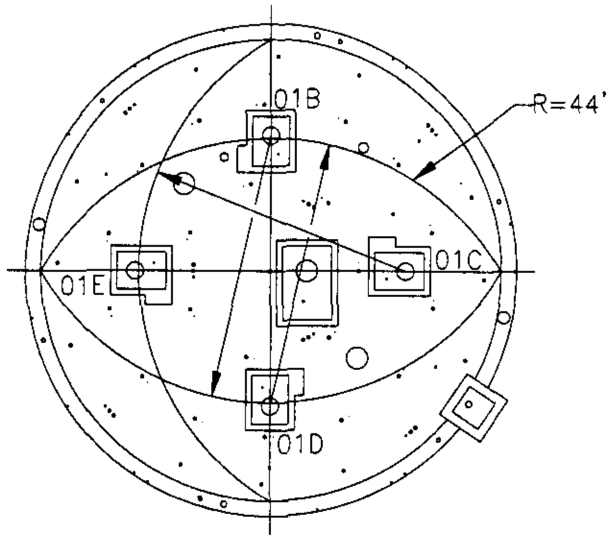

Figure 3-2. Three Pump Combination.

The installation of two mixers opposite each other, the baseline case for all tanks other than AY tanks, is shown in Figure 3-3. This case offers further confirmation that the third mixer is redundant. The same minimum ECR of 44 ft is required in this configuration.

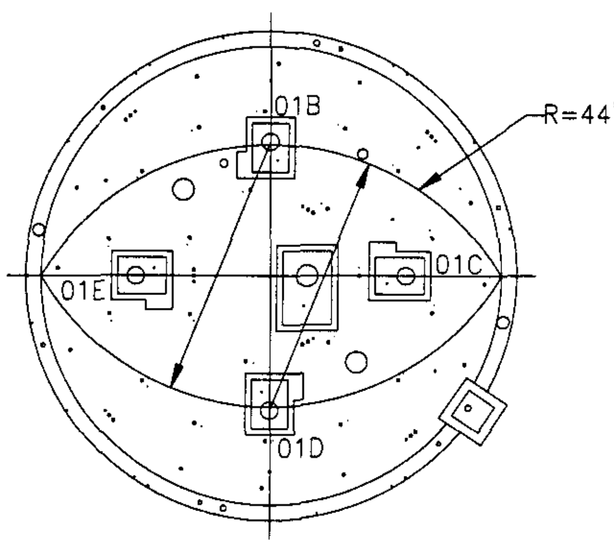

Figure 3-3. Two Pump Combination.

It is concluded that AY tanks can be best mixed with the two or four pump configuration located in the sluice pits. As discussed in section 3.5.2, considerable cost savings can be realized as well as integration with an interfacing project if two pumps can be made to operate within the space available.

3.6.3 Mixer Pump Cleaning Radius and Brake Horsepower Correlation

Using the wealth of literature available on the subject it is possible to develop correlations to estimate the ECR which could be expected from mixer pumps of differing horsepower. Conversely, it is possible to determine the horsepower required for differing ECRs. However, there are uncertainties in this correlation and the predicted ECR (or the horsepower required to effect it) and it is only to be used for conceptual design guidelines. Testing during definitive design analysis will refine these calculations to be able to specify an appropriate pump.

The most straightforward method relates pump horsepower (BHP) and ECR by their common variables flow velocity and area, or dimensions of the jet. (Development and origin of the ECR calculation below, including the shear strength exponent, is discussed later in more detail.)

The key equations to permit this correlation are:

$$ECR = k\,VD\,\tau^{-n} \qquad \text{(Powell 1997), and} \qquad (1)$$

$$BHP = \frac{(V)(A)(448.8)(H)(SG)}{3960\,(\text{eff.})} \qquad \text{(Cameron Hydraulic Data, 15}^{th}\text{ ed.)} \qquad (2)$$

Where ECR = ECR of the jet, feet
- BHP = Brake horsepower
- SG = Specific Gravity
- k = Proportionality constant determined by testing = various (dimensionless)
- V = Velocity of the jet/discharge, ft/sec
- D = Diameter of the nozzle, ft
- τ = Sludge shear strength, lb/ft^2
- n = exponent determined by testing, unitless
- A = Flow area, ft^2
- H = Discharge head, ft of water
- eff. = Pump efficiency, 0.66 (conservative estimate)

In the previously mentioned PNNL 1/12th scale test (including scaled airlift circulators), waste characterization data was meager and NCAW properties were estimated, based upon observation, to have a shear strength of about 10,000 dynes/cm^2. Sludge simulants were prepared that measured 4000 to 17,900 dynes/cm^2. The ECR correlation recommended by PNNL following these tests is:

$$ECR = k\,U_oD\,\tau^{-0.6} \qquad (3)$$

where ECR = ECR of the jet, meters
- k = Proportionality constant determined by the experimental tests to be 1730
- U_o = Velocity of the jet discharge, meters/second (referred to earlier in paragraph 2.2 as V)

D = Diameter of the nozzle, meters
τ = Sludge shear strength, dynes/cm^2

A critical review of the 1987 results was conducted by PNNL in 1991 during which the test run time was acknowledged as a significant variable and should be included. A new correlation was created as follows:

$$ECR = k\, U_o D\, \tau^{-0.729}\, t_m^{0.26} \quad \text{(Powell 1991)} \qquad (4)$$

where ECR = ECR of the jet, meters
k = Proportionality constant determined by experimental tests to be 1095
U_o = Velocity of the jet discharge, meters/second
D = Diameter of the nozzle, meters
τ = Sludge shear strength, dynes/cm^2
t_m = Cumulative mobilization time, hours

These preliminary correlations were proposed based upon limited testing with simulants. They were useful for predicting data but had not been compared with data from an actual waste tank. With the completion of the mixer pump process testing in AZ-101 it is now possible to compare predictions with actual results. Using the following, the calculated ECR (32.2 ft) compares favorably with the results measured in the tests (37.4 ft):

$$ECR = k\, U_o D\, \tau^{-0.46} \quad \text{(Powell 1997)} \qquad (5)$$

where ECR = ECR of the jet, centimeters
k = Proportionality constant, 3 or 4 depending on desired conservatism
U_oD = Jet velocity times jet diameter, 27,300 cm^2/sec (29.4 ft^2/sec)
τ = Sludge shear strength, dynes/cm^2

Recent guidance in determining the retrieval efficiencies of high-level waste (HLW) tanks (Crawford-1999) supplements both the actual (field) experience, provided in Table 1, and the experimental data reported in Powell (1997). This guidance was generated with an interest in establishing the quantity of HLW that can be extracted during retrieval of each feed batch, and thus the total number of HLW canisters of glass that can be expected. Crawford (1999) recommends that future calculations utilize equation (4) above with a proportionality constant of 3.0 to determine the ECR for HLW sludge.

Provided with this guidance, solving equations (1) and (2) for their common variable (U_oD) and then setting them equal to each other yields the parameters of interest.

Solving equations 1 and 2 in terms of velocity:

$$U_o = \frac{BHP\,(3960)\,eff.}{(A)\,448.8\,(H)\quad(SG)} \qquad (6)$$

$$U_o = \frac{ECR}{k(D)} \frac{(\tau^{-0.46})}{(SG)} \tag{7}$$

Equating the two velocity terms allows cancellation of the SG term.

Substituting for U_o yields:

$$BHP = \frac{ECR\,(\tau^{0.46})(A)(448.8)(H)}{(k)(D)(3960)(eff.)} \tag{8}$$

$$ECR = \frac{BHP(K)(D)(3960)(eff.)}{(\tau^{0.46})(A)(448.8)(H)} \tag{9}$$

Substituting known variables yields:

$$BHP = ECR\,(\tau^{0.46})(1.21),\ \text{or} \tag{10a}$$

$$ECR = \frac{BHP}{(\tau^{0.46})(1.21)} \tag{10b}$$

Where the units are expressed as:
- BHP = Brake horsepower, hp
- ECR = ft
- τ = lb/ft^2

Variables:
- k = 3
- D = 0.5 ft
- Eff = .66
- τ = lb/ft^2, varies
- A = 0.196 ft^2
- H = 54 ft, calculated W-151 pump parameters

Figure 3-4 provides a graphical representation of the estimated correlation between ECR and BHP for various waste shear stress values.

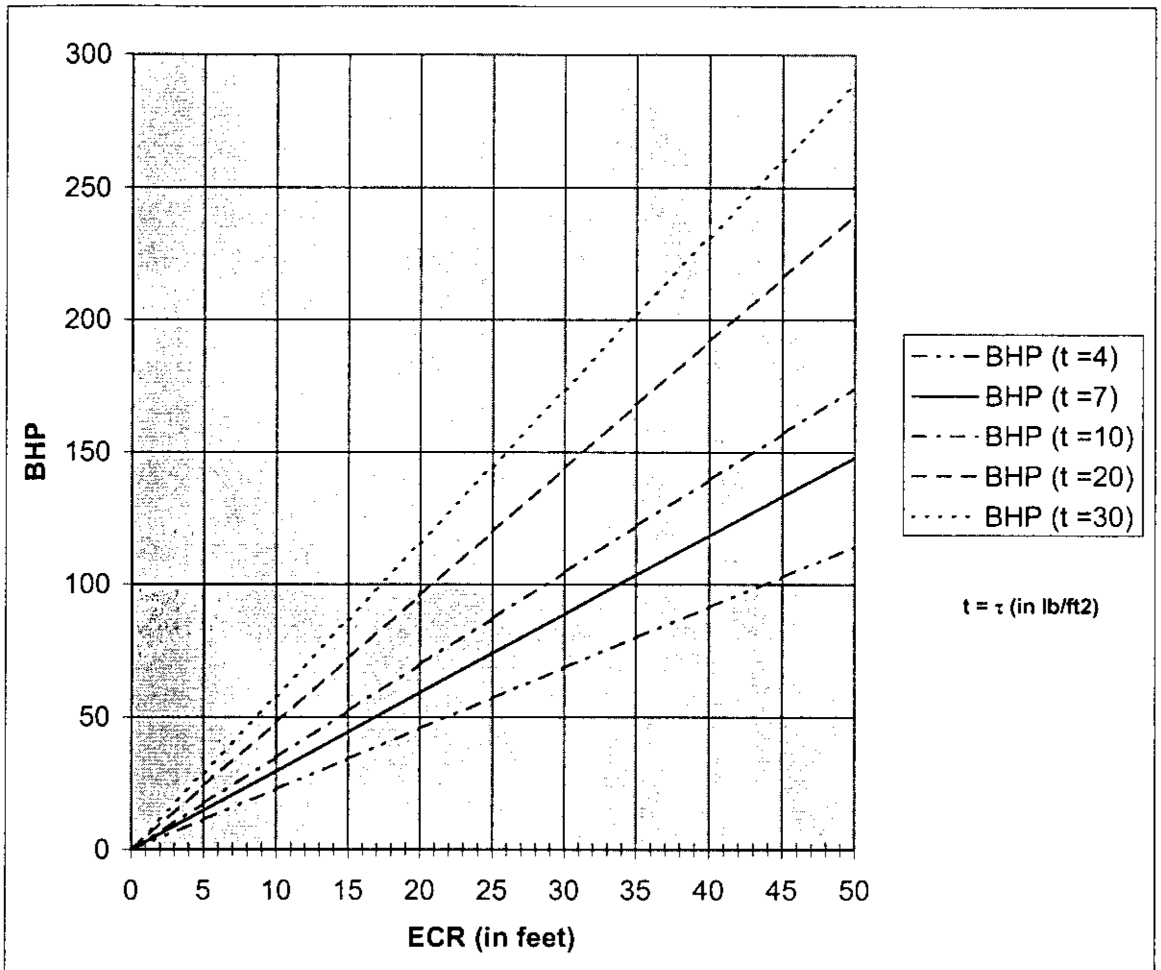

Figure 3-4. Brake Horsepower versus Effective Cleaning Radius.

In the calculation of the ECR required to mobilize 90 percent of the contents of AZ-101 the sludge shear strength has been customarily taken as 10,000 dynes/cm^2 (21 lb/ft^2) and may be considered to be at or near the worse case. Recent sample analyses of the material in C-104, destined to be transferred to AY-101, shows the highest shear strength measured to be 8.2 lb/ft^2 (O'Rourke 1999). Using these two values to bracket the range of potential material conditions for the four mixer pump combination shown in Figure 3-1, the horsepower requirements are shown in Table 3-2.

Table 3-2. Four Pump Arrangement (27 ft ECR).

AY-101/102		
Shear stress (τ)	$\tau = 8.2\ lb/ft^2$	$\tau = 21\ lb/ft^2$
Brake horsepower	86 hp	132 hp

Using the same technique, for the two and three pump combination shown in Figure 3-2 and 3-3 the horsepower requirements are shown in Table 3-3.

Table 3-3. Two/Three Pump Arrangement (43.4 ft ECR).

AY-101/102		
Shear stress (τ)	$\tau = 8.2\ lb/ft^2$	$\tau = 21\ lb/ft^2$
Brake horsepower	138 hp	213 hp

Assuming the worst case (highest shear strength) conditions and the uncertainty in predicting the ECR, the four pump arrangement drive motors would appropriately be specified to be 150 hp. This provides confirmation of the PDC assumption. The two/three pump arrangement drive motors would be specified to be 300 hp. The ECR required to retrieve 90 percent of the tanks is about 41 ft.

3.7 Vendor Contacts

3.7.1 Reduced Diameter Mixer Pump Feasibility

Sulzer expressed confidence in building a successful reduced diameter (31 inch) 300 hp mixer pump with a U_oD equivalent to the available 300 hp 42-in. compatible mixers (29.4 ft^2/sec) (Appendix A). Although the bowl/hydraulic design for such a mixer concept exists, Sulzer has not built one, but one was proposed to the SRS. Sulzer recommends a design study and model testing on an iron prototype model (at an estimated cost in the $100K range). They estimate an impeller (pump) specific speed of 4000-4500, a capacity of 10,400 gpm and a net positive suction head (NPSH) requirement of approximately 24 ft. Sulzer also stated that a multistage unit would also not be out of the question, in order to generate higher head at a reduced diameter.

Sulzer indicated that a major concern with respect to ECR is straightening the flow in the vicinity of the nozzle exit in order to produce a coherent jet. Testing of the model unit could be used to validate the 34-in., 300 hp concepts, optimize the NPSHR requirements, investigate nozzle and casing designs for jet flow characteristics, and test vortexing at the pump suction at the high flow, low submergence conditions. See Appendix A for more discussion on this subject.

Per Sulzer estimations, a reduced diameter design pump would probably cost about the same as the AZ-101 (42-in.-compatible) mixer pump. Most of the cost is in the column and column-related components, and there would be little physical difference between the 42-in. and 34-in. pumps in this area.

Lawrence Pumps was also contacted to determine their interest in developing a conceptual design for mixer pumps suitable for the 34-in. risers. Lawrence was provided with the same tank plan and elevation views and fluid characteristics as were provided to Sulzer. Discussions with Lawrence are also continuing. Lawrence has expressed early optimism for accomplishing the task with a reduced size, modestly increased speed impeller and, because they originated the concept, have mentioned the option of utilizing the gas-filled column pump design.

Both Sulzer Bingham and Lawrence have expressed confidence in their ability to supply mixer pumps that will fit the smaller 34-in. risers and still generate mixing energy equivalent to the 300-hp machines. In the case of AY-101 and 102, the presence of in-tank obstructions will absorb some mixing jet energy that will impact the end result.

In addition to the above design details to be researched, the seal design of the pump should be specified to be effective at reduced speeds. Project W-211 has determined that the seal used in the baseline design begins to lose its effectiveness at approximately 60 percent of full speed. A turndown of at least four to one should be the goal. That is, the seal should be able to effectively seal the volute from the pump column while the pump is operating at one quarter speed.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the discussion and the analysis contained in Section 3.0, the following recommendations are made.

Mixer pumps should be retained as the Project W-521 baseline method of choice for mobilizing, suspending, blending and mixing the contents of the Project's tanks. The Project has the option of selecting from several mixer pump types for a tank-specific application as the design phase evolves and the staging strategy matures.

Maintain one pair of 300 hp mixer pumps per tank, including the AY tanks, as the baseline for Project W-521. Design, fabricate and test prototype 34-in. diameter mixer hydraulics early in the design phase to verify the U_oD. Various site comparable testing and operations seems to back-up the correlation between ECR and the jet U_oD. Based upon this, preliminary calculations can reasonably support this decision.

A pair of reduced diameter 300 hp mixer pumps in AY-101 and AY-102 should be installed in sluice pits 01C and 01E. This approach avails sluice pit 01B in AY-101 for use by W-523, and avoids sluice pit 01D in AY-102 which is encumbered with the sluice transfer pump utilized in the clean out of C-106. The Project costs estimate benefits from this approach in that the 01B and 01D sluice pits in both AY-101 and AY-102 do not have to be entered. The design media and estimate should be revised to reflect these changes. Calculations and historical data support the use of smaller pumps to achieve the desired ECR.

The procurement specification should address the requirement for the pump manufacturer to investigate the design of the nozzle and shaping of the jet by optimizing the design of pump casing (i.e. straightening vanes) and nozzle(s) exit from the volute. Prototype reduced diameter mixer hydraulics should be tested during definitive design to demonstrate the approach proposed by the vendor to address shaping of the jet.

Reducing the diameter of the pump bowl or volute to accommodate the reduced diameter riser will reduce the space available to straighten and control the exiting jet. Previous mixer pump specifications did not place any requirements on the exiting jet flow characteristics other than U_oD. Poor nozzle design will result in swirl or nonaligned flow, negating some of the pump jet(s) effectiveness out near the maximum ECR. A design activity should be pursued to enlist a pump manufacturer(s) analysis, modeling, and testing of pump casings and nozzles.

Specification of a U_oD of 29.4 ft^2/s and a variable speed control should be retained to ensure mixing effectiveness conservatism is built-in. This should be combined with clear delineation of the flow jet characteristics. Despite the apparent success in linear scale up of lab scale ECR results to full scale field work, uncertainty still exists in attempting to predict full scale ECR in actual tank waste. Since the full range of waste material properties which may exist have not been encountered in the field, and the broad range of mixer pump performance parameters which may be required have not been tested, contingency measures must be considered. In addition, appropriate conservatism can be applied in the pump design, both in the specification of available jet energy (U_oD) and in the control over operating speed.

To resolve the issues associated with NPSHA and waste temperature, the following actions are recommended:

- Estimate the amount of time that a mixer pump will be required to operate with an NPSHA less than the NPSHR,
- Word the pump procurement specification to combine cavitation response with the requirement that the pump be robustly designed to achieve design life with intermittent periods of cavitation,
- Perform an evaluation to determine the "most reasonable" NPSHA value to supply to the pump manufacturer,
- Evaluate the possibility of slowing the pump down during low tank levels to decrease NPSHR, and
- Review the pump specification and operational requirements against such expected results as the shadowing effect of components in the tank during mixing.

4.1 Cost

The cost reduction associated with the reduction from four to two mixer pumps per tank in 241-AY tanks is shown in Table 4-1.

Table 4-1. Cost

MIXER PUMP PROCUREMENT - DEDUCT FROM CDR ESTIMATE												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	**TOTAL**
-$2,986,906	-$938,759	-$760,761	-$234,321	-$374,914	-$386,630	-$79,669	-$562,371	-$482,702	-$1,052,483	-$1,644,612	-$2,217,676	**-$11,721,804**

5.0 REFERENCES

Bailey, J.W., March 2000, *"Waste Retrieval Sluicing System (WRSS) and Project W-320, Tank 241-CV-106 Sluicing, Lessons Learned,"* RPP-5687, CH2M Hill Hanford Group, Richland, WA.

Brackenbury, P.J., August 2000, *"W-521 Advanced Conceptual Design Report-Reduced Diameter Mixer Pump Concept for 34 Inch ID Risers,"* 00MM0801, ARES Corporation, Richland, WA.

Carlson, A.B., et al, July 2000, *"Preliminary Test Report, 241-AZ-101 Mixer Pump Test,"* RPP-6548, Numatec Hanford Corporation, Richland, WA.

Carlson, A.B., 2000, *"Preliminary Test Report, 241-AZ-101, "Mixer Pump Test"*, RPP-6548, Rev. 0, CH2M Hill Hanford Group, Richland, WA.

Crawford, T.W. to Hohl, T.M. Letter, April 1999, *"Update of Estimated Retrieval Efficiencies for Phase 1 High Level Waste Feed Tanks,"* 82400-99-020, Lockheed Martin Hanford Corporation, Richland, WA.

Fow, C.L.; Scott, P.A; Whyatt, G.A.; and Ruecker, C.M.; September 1987, *"Development and Demonstration of the Technology for Retrieving Waste from Double Shell Tanks,"* 7W-87-15, Pacific Northwest Laboratory, Richland, WA.

Hylton, T.D., Cummins, R.L., Youngblood, R.L., and Perona, J.J, 1995, *"Sludge Mobilization with Submerged Nozzles in Horizontal Cylindrical Tanks,"* ORNL/TM-13036, Oak Ridge National Laboratory, Oak Ridge, TN.

Onishi, Y., and Recknagle, K.P., July 1998, *"Performance Evaluation of Rotating Pump Jet Mixing of Radioactive Wastes in Hanford Tanks 241-AP-102 and 104,"* PNNL-11920, Pacific Northwest National Laboratory, Richland, WA.

Onishi, Y. and Recknagle, K.P., May 1999, *"Simulation of Hanford Tank 241-C-106 Waste Release into Tank 241-AY-102,"* PNNL-12179, Pacific Northwest National Laboratory, Richland, WA.

O'Rourke, J.F., June 2000, *"Results of Retrieval Studies with Waste from Tank 241-C-104,"* RPP-5798, Fluor Hanford Corporation, Richland, WA.

Powell, M.R., February 1991, "*The Current Status of DST Sludge Mobilization Research Letter Report,*" Pacific National Northwest Laboratory, Richland, WA.

Powell, M.R., Onishi, Y., and Shekarriz, R., September 1997, "*Research on Jet Mixing of Settled Sludges in Nuclear Waste Tanks at Hanford and Other DOE Sites: A Historical Perspective,*" PNNL-11686, Pacific Northwest National Laboratory, Richland, WA.

Schiffhauer, M.A., Groth, J.T. and Scott, D.W., 1985, "Proceedings of the Symposium on Waste Management '85," Volume 2, R. G. Post, ed., pp. 611-619, "The Status of the Waste Removal System for the West Valley Demonstration Project," West Valley Nuclear Services Corporation, West Valley, NY.

Shaw, C.P., Stephens, V.J., and Young, M.W., February 1992, "*Mixer Pump Study for Project W151,*" WHC-SD-WM-ES-195, Westinghouse Hanford Company, Richland, WA.

Shaw, C.P., 2000a, "*Net Positive Suction Head Available Analysis for Phase 1 Waste Tanks,*" RPP-5585, CH2M Hill Hanford Group, Inc., Richland, WA.

Shaw, C.P., 2000b, "*Double-Shell Tank Mixer Pump Subsystem Specification,*" HNF-4164, CH2M Hill Hanford Group, Inc., Richland, WA.

Waters, E. D., February 1994, "*Background and Status of Hanford's DST Retrieval Technology*", WHC-SD-WM-TI-593, Westinghouse Hanford Company, Richland WA.

Weaver, S.J. August 1999, "*Project Definition Criteria for Project W-521, Waste Feed Delivery Systems,*" HNF-4408, Rev 0., ARES Corporation, Richland, WA.

Whyatt, G.A., Sterne, R.J., Mattigod, S.V., and Onishi, Y., September 1996, "*Potential for Criticality in Hanford Tanks Resulting from Retrieval of Tank Waste,*" PNNL-11304, Pacific Northwest National Laboratory, Richland, WA.

Appendix A
Meeting Minutes
W-521 Project, Reduced Diameter Mixer Pump Concept for 34-in. ID Risers

HND TEAM — MEETING MINUTES

DATE:	August 1, 2000	**TIME:**	8:00 a.m.	**FILE:**	00MM0801
MEETING	X	**T-CON**		**PHONE NO.**	

SUBJECT: **W-521 ADVANCED CONCEPTUAL DESIGN REPORT - REDUCED DIAMETER MIXER PUMP CONCEPT FOR 34 INCH I.D. RISERS**

LOCATION: ARES Corporation, 636 Jadwin Ave., Suite B, Richland, WA

PARTICIPANTS

- Phil Brackenbury
- Steve Briggs
- Roger Davey
- Dave Eddy
- Marshall Hauck
- Bill Powell
- Steve Riesenweber

COPIES: Katie White
9909202.03 Job File (RL & BG)
Meeting Minutes Book

PREPARED BY: Phil Brackenbury **DATE PREPARED:** AUGUST 2, 2000

//S// ORIGINAL SIGNED BY //
SIGNATURE

- Sulzer described their operations and location of major facilities. It was of interest to participants that there is precedence for forming a purchasing alliance with some buyers (in the petroleum industry for instance) wherein a priced order agreement is entered and pumps are purchased as necessary by the buyer. These arrangements are known to last 3-5 years. W-211 Project personnel stated that they had discussed forming such an alliance but found it was not possible due to the inability to fund it. (W-211 has no outstanding contract for pumps. They are due to go out for bids for pumps again, with a performance-based specification, in about a year.)

- The W-151 Project purchased three mixer pumps (two plus a spare) and the W-211 Project has purchased two. All use seals manufactured by John Crane. These have a lower speed limit of 60% of full speed that is a source of concern. A better goal would be something like 25%.

- Sulzer expressed confidence in building a successful reduced diameter 300 hp mixer pump with a U_oD of 29.4. Although the bowl/hydraulic design for such a mixer concept exists, Sulzer has not built a reduced diameter mixer of this capacity before. Sulzer proposed such a machine to the Savannah River Site (SRS) and left ARES a copy of their SRS proposal. They would recommend a design study and model testing on an iron prototype model (at an estimated cost in the $100K range), an impeller (pump) specific speed of 4000-4500, 10,400 gpm capacity with a net positive suction head (NPSH) requirement of approximately 24 ft. Sulzer indicated that one major concern is straightening the flow in the vicinity of the nozzle exit.

A multistage unit would also not be out of the question, in order to generate higher head at a reduced diameter.

- The 24 ft NPSH required raised concerns over the available value (various sources range from 12 ft - 19 ft). It was suggested by Sulzer that too conservative of NPSHA specified causes the impeller eye to be opened up thereby causing suction recirculation and vibration if NPSHA values are much higher than that specified. Project W-521 should evaluate to assure that values specified are reasonable.

- Sulzer stated that a reduced diameter design would probably cost about the same as the AZ-101 (42 inch-compatible) mixer. Most of the pump cost is in the column and there would be little difference in this part of the pump.

- Sulzer stated that they had looked briefly at reducing the diameter of their conventional quad-volute design and found that it was challenging to achieve the dimensions compatible with 34-inch ID risers. They believed it might be easier to make a tri-volute work. The problem is with getting the turning vanes required to straighten the flow and shape the jet into the reduced diameter volute.

- Sulzer reminded the participants that the performance of impellers in this specific speed range does not abruptly disappear as NPSH diminishes but instead gradually wanders, "like a drunk", toward less and less discharge head. The importance of recognizing this, as the specifications are prepared, was stressed. It is quite possible to expect performance to continue throughout the limited (5000 hr) life of these units at NPSH values less than the 24-ft case. Loss of performance due to diminished submergence (swirling and air entrainment, or mining cavities in viscous sludges) is more likely and should also be of concern. Sulzer would expect this to occur at a submergence of something like 2/3 the height of the bowl. In the case of this reduced diameter mixer the bowl would be 30-40" in height.

- It was suggested that model testing be performed for the first unit to refine the redesigned pump-end and establish minimum submergence versus pump speed criteria.

- The importance of nozzle configuration was discussed with respect to the effect of the discharge jet characteristics on the ECR. It appears that the pump manufacturer should be required to optimize and test their nozzle design in the pump specification.

- Sulzer indicated they will take another look at the bowl end of their reduced diameter configuration, proposed for SRS, as further confirmation that it would be suitable for the application. They also indicated that they will look further at the modified quad-volute to see if there was a chance of making it work. Sulzer will contact ARES during the week of August 7th with the results of their additional evaluation.

- In addition to the reduced diameter SRS mixer proposal, Sulzer also left copies of crossections of their quad-volute configuration.

ADVANCED CONCEPTUAL DESIGN PROCUREMENT SPECIFICATION FOR WASTE MOBILIZATION MIXER PUMP

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Task 00008
Report No. 990920201-012
Revision 0

September 2000

prepared by

HND TEAM

PRELIMINARY

ADVANCED CONCEPTUAL DESIGN PROCUREMENT SPECIFICATION FOR WASTE MOBILIZATION MIXER PUMP

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Task 00008
Report No. 990920201-012
Revision 0

September 2000

Prepared by: Steve Riesenweber

Approved by: ____________________
Larry Shipley, P.E.

Date: ____________________

PRELIMINARY

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Figures

Tables

Acronyms

ASME	American Society of Mechanical Engineers
FM	Factory Mutual
UL	Underwriters Laboratory
VFD	Variable Frequency Drive

1.0 SCOPE

This specification provides requirements for the procurement, packaging, and shipping of mixer pumps for the Project W-521, Waste Feed Delivery Systems.

1.1 Work Included

Design, fabrication, assembly, testing, and delivery of Mixer Pumps each with support column, mounting flange, and drive motor is included in the scope of this specification.

1.2 Work Not Included

Design and delivery of interconnecting power, control and instrumentation cabling beyond the mixer pump cable support/junction boxes, variable frequency drive, and water supply services (e.g., for the flush) beyond the mixer pump connection points is not included in the scope of this specification. Design and delivery of vertical indexing system is also excluded.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent indicated in the referenced drawings and documents. The latest edition with addenda shall be used unless noted otherwise.

2.1 Non-Government Documents

2.1.1 American Concrete Institute (ACI)

- 349 Code Requirements for Nuclear Safety Related Concrete Structures.

2.1.2 American Gear Manufacturer Association (AGMA)

- 390.03A Gear Classification Handbook.

2.1.3 American National Standards Institute (ANSI)

- B46.1 Surface Texture (Surface Roughness, Waviness and Lay).

2.1.4 American Petroleum Institute (API)

- Standard 610, Seventh Edition Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services.

2.1.5 American Society of Mechanical Engineers (ASME)

- Section IX Boiler Pressure Vessel Code.
- B & PVC Boiler and Pressure Vessel Code.
- B30.20 Below-The-Hook Lifting Devices.
- B31.3 Process Piping.
- ANSI Series Engineering Drawings and Related Documentation Practices.

2.1.6 American Society for Nondestructive Testing (ASNT)

- SNT-TC-1A Recommended Practice.

2.1.7 American Society for Testing and Materials (ASTM) Standards

- A 380 Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

2.1.8 American Welding Society (AWS)

- D1.1 Structural Welding Code-Steel.
- QC1 Standards for AWS Certification of Welding Inspectors.

2.1.9 Factory Mutual System(FM)

- Approval Guide.

2.1.10 Hydraulic Institute (HI)

- 1.6 Centrifugal Pump Tests.

2.1.11 National Electrical Manufacturers Association (NEMA)

- MG 1 Motors and Generators.

2.1.12 National Fire Protection Association (NFPA)

- 70 National Electric Code (NEC).

2.1.13 Underwriters Laboratories (UL)

- 508 Safety Industrial Control Equipment.

3.0 TECHNICAL REQUIREMENTS

3.1 Item Definition

The major items that makeup the mixer pump assembly to be provided by the Supplier are as follows:

a. Pump, including impeller, volute casing, and suction strainer,

b. Drive motor,

c. Mixer Pump mounting flange with a radiation shield plug,

d. Support Column,

e. Turntable/rotation mechanism with appropriate adapter flanges,

f. Nozzles (these may be integral with the pump casing),

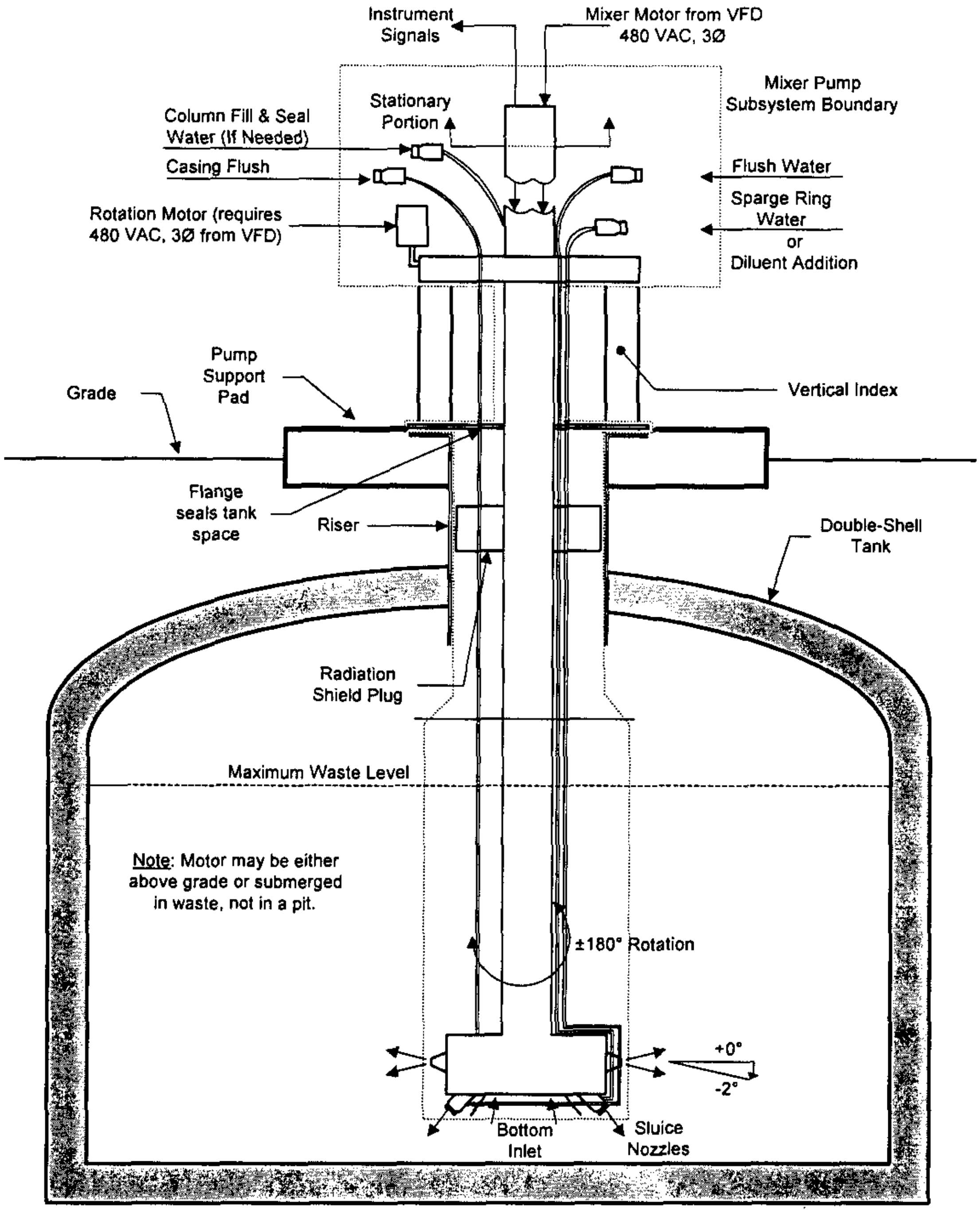
g. Pump casing flush and associated supply line,

h. Suction inlet sparge ring and associated supply line, and

i. Column water supply and drain lines, if required.

3.1.1 Item Diagram

The mixer pump assembly and its interface with the waste tank are shown in Figure 3-1. The figure identifies major items comprising the mixer pump assembly referred to in section 3.0. Other items shown are for clarity only.



VAC = Volts alternating current
VFD = Variable Frequency Drive

Figure 3-1. Typical Mixer Pump Configuration.

3.1.2 Interface Definition

a. The Double Shell Tank (DST) Mixer Pump System shall provide a connection capable of providing water at a flow rate of ≥ 140 gal/min at 40 psig to sluice nozzles located below the pump suction in order to remove sludge and settled solids from below the pump to facilitate pump installation, aid pump start-up after periods of inactivity, and add bulk dilution water.

b. The DST Mixer Pump System shall provide a connection capable of providing water at a flow rate of ≥ 140 gal/min to the pump suction area in order to remove sludge and settled solids from below the pump to facilitate pump installation, aid pump start-up after periods of inactivity, and add bulk dilution water.

c. The DST Pump System shall provide a connection capable of providing water at ≥200 gal/min to the pump cavity to enable flushing of the pump cavity to clear accumulated solids and internal flushing for decontamination at end of life.

d. The DST Pump System shall provide a connection capable of providing water to fill the pump column and the mechanical seals if required by specific pump design.

e. Pump-mounted instrumentation with signals shall terminate above the mounting flange.

f. The pump shall provide a 20 ft electrical lead originating from the motor terminal box suitable for 460V 3-phase power.

3.2 Characteristics

Mixer pumps will be installed with a crane, lowered vertically into an existing underground radioactive waste storage tank. The tank is approximately 47 ft high and 75 ft in diameter, and contains 42-in. diameter or 34-in. diameter riser flanges for pump installation.

3.2.1 Functional Characteristics

a. The function of the mixer pump is to mix sludge/salts that have settled on the tank bottom with liquid within the tank in order to aid in dissolving soluble salts or achieve a homogenous mixture of tank contents. The mixer pump speed will be controlled by a Variable Frequency Drive (VFD) located up to 550 ft away from the pump, and its operating speed will be adjusted to suit conditions.

b. The mixer pumps suction will intake from the bottom of the pump and discharge horizontally through two opposing, nozzles at an elevation of approximately 15-in. from the tank bottom. The entire pump assembly may be indexed above this level; but the indexing system is not to be provided by the pump manufacturer. Rotation of the nozzles (or entire assembly) is required to "sweep" the entire bottom.

c. Each mixer pump shall provide two jets, 180° opposed, with velocity-nozzle diameter product (U_oD) that is a minimum of 29.4 ft^2/s (2.73 m^2/s) at 100 percent speed with a minimum impeller submergence of 3 ft (91 cm). The center of the discharge nozzle shall be <TBR> inches above the lowest point on the pump suction.

3.2.2 Physical Characteristics

a. The pumps shall be installed in a 42-in. nominal diameter riser; the maximum diameter of pump components below the mounting flange shall be limited to 39-in.
OR

b. The pump shall be installed in a 34-in. nominal diameter risers, the maximum diameter of pump components below the mounting flange shall be limited to 31-in.

c. Mixer pump components located above the mounting flange shall not extend more than 24-in. radially from the pump centerline in order to be compatible with the disposal system design.

d. Overall mixer pump length shall be as specified on drawing <TBD>.

e. A radiation shield plug shall be installed around the mixer pump column to minimize radiation streaming through the riser (see Figure 3-1). Details for the shield plug configuration are contained in drawing <TBD>.

f. The maximum outside diameter of all assembled components below the mixer pump-mounting flange shall not exceed 39-in. in diameter or 31-in. diameter based on detailed information to be provided by the Buyer. During mixer pump removal, the mixer pump assembly, excluding the turntable assembly, will be drawn (lifted) into a receiver bagging assembly that will allow the pump to be sealed inside the bag. Mixer pump components above the mixer pump-mounting flange shall not exceed 48-in. in diameter.

g. Maximum mixer pump assembled weight, (the load placed on the tank dome), including the motor and the turntable assembly, shall not exceed 28,000 lb.

h. The pump turntable assembly shall be located above grade. The mixer pump turntable and drive motor shall be capable of operation in both clockwise and counterclockwise directions to a minimum of 180 deg.

i. The mixer pump assembly and turntable will be bolted on a support platform supplied and installed by the Buyer. All mixer pump components below the mounting flange must fit through the support platform riser. Details for the shield plug configuration are contained in drawing. <TBD>. Details for the shield plug configuration are contained in drawing <TBD>.

j. The pump column (if required by design) shall be drainable.

k. Pump cavities that are in contact with liquid waste shall be fully drainable without requiring direct personnel contact and accessible for flushing and/or remote decontamination.

l. Pump System shall contain waste leakage below the pump mounting plate and direct any potential leakage back into tanks.

m. Mixer pump components, including pump seals, shall be capable of performing their intended functions from 25 % to 100 % rated full speed. Zero in-leakage is allowed into the pump column when pump is idle or operating.

n. Pump seals or other design features upon failure shall not provide a pathway for tank waste liquids or gases to the environment.

o. The DST Mixer Pump shall not exceed the following demand for strained raw water. Filtering to $\leq$5 micron at the mechanical seal (if required by design) is part of pump design.

- Supply pressure = 80 lbf/in^2 gauge.
- Flow rate = 5 gal/min.

p. Pumps shall be provided with lifting bails. Lifting bails and any special yokes or spreaders shall be provided that enable handling of the mixer pump in the horizontal and vertical positions, while allowing insertion of system into the DST.

q. Mixer Pumps shall be capable of being lifted to an upright position from a horizontal position by a crane from a single point on the mounting flange end without damage to the pump or its components.

r. Lifting lugs or eye bolts for handling shall have a safety factor of three based on yield strength or five based on ultimate strength, whichever is most conservative.

s. Pumps shall be provided with a sparge ring (spray ring) near the pump suction. This ring shall be configured in a manner that will loosen and move sludges away from the pump suction during pump installation. Capability shall be provided, via a flanged connection, to deliver water to the sparge ring at a flow rate of 140 gpm <TBR> with a supply pressure of <TBD> lb/in^2 gauge.

t. The Mixer Pump shall provide means of internally flushing the pump bowl or volute to reduce internal contamination levels before or during pump removal from tank. Pressure drop from the supply water connection to the pump casing shall not exceed 10 psig. Water will be supplied at the pump mounting flange according to the following minimum parameters:

- Supply Pressure = 40 psig and
- Flow Rate = 200 gal/min.

u. The power supply to the mixer pump motor and the turntable VFDs shall be 480 VAC, 3-phase, 60 Hz. The Supplier shall verify that the pump motor is compatible with a Cutler Hammer SV9000 VFD.

v. The mixer pump motor, if not of submersible design, shall be a vertical type and shall be designed to satisfy National Electrical Manufacturers Association (NEMA) Chapter MG-1.

w. The mixer pump motor shall be equipped with a variable speed drive. Pump and motor shall be capable of extended operation at pump speeds ranging from 100 rpm to 100% design speed <TBR>.

x. A VFD shall be supplied by the Buyer to control rotational speed of the Supplier supplied gear motor on the turntable assembly. The rotational speed shall be adjustable from 0.05 to 0.2 rev/min shall power the mixer pump turntable drive. The turntable and the motor point of contact shall have a gear guard installed to withstand the tank environment.

y. Electrical equipment enclosures shall be as a minimum National Electrical Manufacturers Association (NEMA) Type 4, per NEMA ICS 6.

z. Electrical grounding shall be provided for all Mixer Pump System electrical systems in accordance with the National Electrical Code (NFPA 70, 1999).

aa. Electrical materials and equipment shall be UL or FM tested, with label attached, for the purpose intended, whenever such products are available. Where there are no UL or FM listed products of the type, testing and certification shall be approved by the Buyer's Technical Representative.

bb. The Mixer Pump System shall provide fixed, non-rotating, environmentally protected field terminations for all power and signal connections that comply with applicable *National Electrical Code* and standards.

cc. The system shall comply with electromagnetic radiation emission requirements <TBD>.

dd. The DST Mixer Pump System shall include sensors/instrumentation to provide remote readout of the following parameters: bearing temperature, pump vibration, motor stator winding temperature, turntable rotation and orientation, discharge nozzle pressure, sweep speed, revolutions per minute, and motor amperage <TBR>. Revolutions per minute (rpm) shall be measured by a dedicated mechanical/electrical device; VFD output will NOT be allowed as the speed-measuring device.

ee. A drain hole shall be provided on the turntable assembly, if the design/assembly of the turntable is such that it may collect rainwater or snow.

3.2.3 Reliability

a. Mixer Pumps, including the turntable assembly, shall be designed for 5,000 hours of operation over a 10-year period, including repeated operational cycles with multiple starts/stops.

3.2.4 Maintainability

a. Components located within pump pits or below the mounting flange shall be designed for no preventive or corrective maintenance during the design life, other than flushing or bumping.

b. Components located above the mixer pump mounting flange shall be designed for limited contact maintenance.

c. The Supplier shall provide written recommendations of operational practices such as bumping and flushing to maximize useful life.

d. Pump column shall not be equipped with relief valves, rupture disks, or any other device that requires periodic inspection or maintenance.

3.2.5 Environmental

a. Mixer pump components located below the mounting flange shall be designed for the radiation fields and cumulative radiation exposure indicated in Table 3-1.

Table 3-1. Bounding Radiation Fields and Cumulative Radiation Exposure

Source Tank	Radiation Field (Rad/hr)	10 Year Cumulative Exposure (rad)
LAW Tanks	500	2.5×10^6
HLW Tanks	1000	5.0×10^6

b. Components in contact with tank waste shall be designed to perform their intended functions in the chemical environment shown in Table 3-2.

Table 3-2. Mobilized Slurry Composition

Constituent	Concentration (M)
NaOH	0 to 2.5 (generally 1.0)
$NaAlO_2$	0 to 2.0
$NaNO_2$	0 to 3.0
$NaNO_3$	0 to 4.0
Na_2CO_3	0 to 0.5
Na_3PO_4	0 to 1.0
Na_2SO_4	0 to 1.0
NaF	0 to 0.2
Total Na^+	<5.5

c. Mixer pump system components shall be designed to operate in tanks with waste constituents having the following fluid properties: Note: *This table will be expanded to reflect the waste property values of initial and re-fill conditions in each tank.*

Table 3-3. Waste Property Values

Waste Property	Minimum Value	Maximum Value	Nominal Design Value
Specific Gravity	1.0	1.4	1.2
Viscosity (CP)	1	50	10
Miller Number		100	
pH	7	13+ **(TBR)**	
Temperature (°C)	10	130	100
Solids (Vol. %)	0	50	20
Particle Size (microns)	0.5	4000	See note

Note: 95% of total particles 0 to 50 microns <TBR>.
<5% of total particles 50 to 500 microns <TBR>.
<1% of total particles 500 to 4000 micron <TBR>.

d. System components shall be fabricated using materials compatible with waste solutions as specified above.

e. Mixer pumps shall be designed to operate with a minimum of <TBD> ft Net Positive Suction Head (NPSH) available. <TBR>

f. The system shall be designed to withstand natural phenomenon hazards listed below <TBD>.

g. If a submersible pump is provided, the pump shall be capable of operation, with no detrimental effects to the motor, with the motor operating in air (not submerged).

3.2.6 Safety

a. The top 8-in. of lifting attachments shall be painted yellow.

b. Mixer pump shielding shall be designed to keep personnel exposures as low as reasonably achievable (ALARA). <TBR>

c. Mechanical tooling, equipment, and materials (including lubricants, adhesives, gaskets, corrosion inhibitors, epoxies, etc.) used inside of the pump pit that are in communication with the tank dome vapor space shall be constructed of spark-resistant material, or shall be rendered incapable of sparking with sufficient energy to combust flammable gases occurring within the tank vapor space, or shall have been analyzed and evaluated to be incapable of sparking with sufficient energy to combust flammable gases occurring within the tank vapor space under the applied conditions. All components shall comply with Class 1, Div. 1, Group B environment for submerged components and Class 1, Div 2, Group B for all other parts below the flange per National Fire Protection Association Chapter 70 (NFPA 70).

3.3 Design and Construction

3.3.1 General Design Requirements

a. The mixer pump shall meet the applicable design, fabrication, the highest degree of dynamic balancing, and testing requirements contained in American Petroleum Institute (API) 610.

b. Designs should simplify cut-up, dismantlement, removal, and packaging of contaminated pumps for final disposal as radioactive mixed waste.

c. The mixer pump shall be designed to minimize the net positive suction head required.

d. The mixer pump shall be designed such that gradual reduction in head occurs as cavitation increases. The pump shall be designed to withstand intermittent periods (i.e. 40 hours cumulatively) of cavitation and still achieve its desired design life. <TBR>

e. The pump design shall minimize internal and external cracks, crevices, and hold-up to facilitate pump cleanup for disposal.

f. Internal voids below the maximum waste level shall either be flushable, pressurized, filled, or sealed to minimize the pump's source term of radioactive material at end of life.

g. All welds that will be in contact with waste shall be designed to eliminate crud traps. <TBR>

h. The DST Mixer Pump System support foundations shall be designed in accordance with the American Concrete Institute standard ACI 349.

i. System components shall be designed to withstand the shock and vibration environments during normal transportation.

j. The equipment design shall minimize the time required to physically disconnect, remove, and replace the mixer pump.

3.3.2 Parts/Materials/Processes

3.3.2.1 Material Requirements

a. Metal Components: All metal components in contact with the process fluid should be the manufacturer's standard 300 series stainless steel or other Buyer-approved material. The pump shaft should be hardened 400 series stainless steel or 17-4 PH stainless steel. Any welded component in contact with the process fluid should be constructed of 304L/316L stainless steel. Materials used for pressure boundary parts, fasteners, and rotating members, including the impeller and shafting, shall be new, conform to ASTM or ASME standard specifications, and be provided with Certified Material Test Reports (CMTRs).

b. Nonmetal Components: All nonmetallic components located below the mounting flange will be submitted for evaluation by the Buyer as to suitability for the radiation environment. Selection of nonmetallic components for requirements other than radiation are the Seller's responsibility. Components shall be compatible with waste characteristics as described in Table 3-1, 3-2, and 3-3. A supplier's certificate of conformance of the non-metallic components used in fabrication is required.

c. Brass, bronze, and copper base materials, if used, shall not come in contact with the waste tank fluid or vapor. The use of aluminum is not acceptable.

3.3.2.2 Fabrication

a. The mixer pump column and auxiliary supply/drain piping and piping connections and shall be welded and inspected in accordance with ASME B31.3. Other non-pressure-retaining mixer pump components shall be welded in accordance with ASME B31.3 or AWS D1.1, as applicable.

b. All pump structural connections that require welding shall be welded in accordance with American Welding Society (AWS) D1.1.

c. Welder Qualification: All personnel performing welding shall be qualified to ASME B31.3 or AWS D1.1, as applicable. ASME Section IX qualifications may be substituted for ASME B31.3.

3.3.2.3 Spare Parts/Special Tools

a. Seller shall furnish two sets of special tools unique to Seller's equipment that are necessary for installation, startup, operation, maintenance, and adjustment of the mixer pump. (Note: only two sets of tools are required for entire order, not two sets/pump).

3.3.3 Cleanliness

a. The inner and outer surfaces of the pump shall be cleaned removing all foreign matter such as grease, oil, dirt, tape adhesives, weld splatter, and other contaminants.

b. Mechanical cleaning tools used on stainless steel shall not have been previously used on carbon steel or any other materials that would contaminate stainless steel surfaces.

c. Wire brushes used for cleaning shall be stainless steel.

d. Grinding wheels used for cleaning shall be resin-bonded aluminum oxide.

e. Cleaning solutions shall not contain halogenated compounds.

f. Grinding or machining of stainless steel shall be done with tools that have never come into contact with carbon steel.

g. The edges of exposed components shall be rounded so that no sharp edges or burrs are present.

h. Material Handling: Clamps, wedges, temporary clips, and other small items that are welded or mechanically fastened to stainless steel shall be made of stainless steel only. After removal of temporary attachments welded to the pump, the surface shall be ground flush and dye penetrate tested. It is acceptable to use high-strength carbon steel clamping devices such as machine chuck jaws provided they pass ASTM A 380, paragraph 7.2.5.1, test for evidence of carbon steel contamination. If carbon steel contamination is evident, the surface shall be ground, and the test shall be repeated until the contamination is removed.

i. Surface Finish: Surface finishes of pump components below the riser flange shall be a cost/benefit analysis at detail design by the project. All surfaces exposed to the waste fluid shall be free of pits; scratches, gouges, and sharp weld ripples that could entrap solids. Surface roughness shall be determined in accordance with ANSI B46.1. If mill surface finish on materials meets this requirement, then surfacing is not required.

3.3.4 Corrosion of Parts

a. Stainless steel components do not require painting except as needed for identification or for targeting. Paint used on stainless steel shall be epoxy-phenolic.

3.3.5 Protective Coatings

a. Painting: All carbon steel shall be painted to the Seller's standard practice. All paint shall be suitable for chemical duty and exposure to outside environmental conditions.

b. Exposed carbon steel surfaces above the riser flange shall be painted gray with epoxy paint.

3.3.6 Interchangeability

a. All like equipment and parts shall be interchangeable/standardized to the maximum extent practical.

3.3.7 Nameplate

a. Mixer pumps shall be provided with a stamped stainless steel tag with the following data: manufacturer's name, manufacturer's part/item number, drawing number, year manufactured, and specification number and revision(s).

b. Motors shall be provided with a stamped stainless steel identification tag in accordance with NEMA NG - 1 requirement.

c. The mixer pump identification tag shall be visible after pump installation.

3.3.8 Qualification

a. Each mixer pump shall be tested for hydraulic and mechanical performance, vibration response, and other special testing as called out in *Hydraulic Institute Standards*. A test plan shall be written by the Supplier and provided to the Buyer for approval prior to test performance.

b. Capability shall be demonstrated to lift the mixer pump assembly and lower it allowing straight vertical insertion into the DST.

c. The Buyer shall provide design and test data for the pump/nozzle configuration to verify that jet flow is optimized (i.e. non-swirling, diverging) to assure that the desired cleaning radius can be achieved. <TBR>

3.3.9 Document Submittal

3.3.9.1 General Requirements

a. All submittals shall include this specification number, item number, PO number, and Seller's identification number on all submittals.

b. Data shall be sufficiently clear to allow legible copies to be made on standard reproduction equipment after microfilming.

c. Approval by the Buyer does not relieve the Seller of responsibility for accuracy or adequacy of design under this specification.

d. Submittals "not requiring approval" will be reviewed to verify completeness and adequacy for their intended purposes.

e. A Submittal that is not approved is identified as "Not Approved, Revise and Resubmit." The submittal is considered technically deficient, or incomplete, and therefore unacceptable. Resubmittal is required; hence fabrication, procurement, or performance of procedures shall not proceed.

f. Submittals "not requiring approval" that are determined to be incomplete or inadequate will be returned marked "Resubmit." An explanation of the deficiencies will be included for corrective action by the Seller. Fabrication or other seller processes may proceed at the seller's risk.

3.3.9.2 Submittals Required

a. Quality Assurance Program (Approval – Prior to contract award).

b. Fabrication Drawings (Approval – Prior to Fabrication).

c. Test Plan (Approval – Prior to completion of Fabrication).

d. Maintenance and Operations Manual (Approval – Prior to final shipment).

e. Seller shall provide a list of special tools furnished, identifying the function of each tool and the specific items(s) for which it is used. Seller shall also indicate whether the tool is required for assembly, disassembly, installation, start-up, operation, maintenance, or adjustment (Approval – Prior to final shipment).

f. Nondestructive examination inspections shall be recorded and included with the Final Design Report (Approval – Prior to final shipment).

g. CMTRs shall be provided for all metal materials supplied by the seller (Approval – Prior to pump shipment).

h. Written recommendations of operational practices, such as bumping and flushing, to maximize useful life shall be provided with the Final Design Report (Information Only – Prior to design approval).

i. A Recommended Spare Parts list shall be provided with the Final Design Report. Determination of spare parts shall be based on the documented mean time between failures of components (Information Only – With Final Design Report).

4.0 QUALITY ASSURANCE REQUIREMENTS

4.1 General

The Seller shall have in place a Quality Assurance/Control Program that assures that the fabrication and testing of the product are performed in accordance with the Sellers established procedures. These procedures shall be such as to ensure that the construction and fabrication of the product meet the quality, functional, and operational requirements specified in this specification and those called out on the approved drawings.

The Sellers program shall be submitted for approval in accordance with the requirements set in the Submittal Section of this specification and the Contract Documentation.

4.1.1 Responsibility for Verification

a. The Supplier shall be responsible for performance, inspection, and documentations of tests, personnel qualifications, and other submittal information required in this specification in accordance with the Supplier's Quality Assurance Plan.

4.1.2 Verification Methods

a. The system design shall be verified to RPP-PRO-1819 <TBR>, Engineering Requirements.

4.2 Qualification Verification

a. The Supplier's shall document performance of all qualification testing identified in Section 3.3.8.

b. The Buyer reserves the right to witness any testing performed.

4.3 Inspections and Tests

a. Inspector Qualifications: All personnel performing Nondestructive Examination (NDE) shall have been certified in accordance with the Seller's written practice, which shall meet the requirements of ASNT SNT-TC-1A. Level II or III personnel shall be used to interpret test results.

b. Welder and Inspector Files: The Seller shall maintain a file containing welder and inspector certifications, and NDE performance procedures as applicable, at the fabrication site for Buyer's evaluation.

c. Visual weld inspections shall be performed, and appropriate documentation prepared by Certified Welding Inspectors (CWI) who have received certification in accordance with AWS QCI. Certified Associate Welding Inspectors (CAWI), certified in accordance with the above standard, may perform examination. Where CAWIs perform examinations, documentation shall be signed or stamped by both CAWIs and CWIs under whom the examinations were performed and included in the Final Design Report.

d. Visual examination shall be performed on pressure-retaining parts, i.e., pump column and auxiliary supply, flush and drain piping, in accordance with ASME B31.1.

e. Bail and lifting yoke welds shall be liquid-penetrate or magnetic-particle inspected in accordance with AWS D1.1.

f. Each mixer pump column shall be hydrostatically tested to 150 percent design pressure.

g. All lifting yokes shall be load tested to 125 percent of the rated load.

h. The DST Mixer Pump subsystem shall be tested in accordance with *Hydraulic Institute Standards*.

5.0 PREPARATION FOR DELIVERY

5.1 General

a. Delivery shall not commence until all required submittals (Section 3.3.9) are received and approved by the Buyer.

5.2 Preservation and Packaging

a. Item shall be protected from dirt, soil, and moisture.

b. Equipment shall be boxed or crated in a manner to prevent damage during shipping. Where equipment is braced internally, it shall be marked to identify removal. The Mixer Pump assembly, (excluding the pump motor), and turntable assembly shall be assembled (fastened) together and shipped as a complete, assembled package. The drive motor shall be packaged separately and mounted vertically on its base face. Loose components shall be bagged or boxed and supplied within the Mixer Pump crating. Assembly instructions shall be provided with each pump unit.

5.3 Marking

a. Each Mixer Pump shall be identified with a permanent stainless steel nameplate. The nameplate shall be attached in a location that will be visible after installation. The characters shall be stamped or etched; painting is not acceptable. The nameplate shall depict the following information in 25-in. high characters.

- Purchase Order number.
- Item Number.
- Buyer equipment piece number (if identified on the purchase order).
- Specification and revision number.

b. The turntable assembly (gear and cover plate) shall have a zero degree indication mark placed on each component to indicate the relative position of the pump assembly (nozzles).

c. Packages shall be suitably marked on the outside to facilitate identification of the purchase order, the procurement specification, the package contents, and special handling instructions.

d. Each electric motor shall have a nameplate permanently attached in accordance with NEMA MG 1.

5.4 Handling

a. If special handling devices are needed for assembly or installation of equipment, those devices shall be identified as special equipment and shall be supplied with the pump assembly.

5.5 Shipping

a. Seller shall recommend the preferred method of shipping (i.e., fully assembled or partially assembled) to provide the best protection of equipment during transit and storage. The boxed or crafted components shall be blocked and securely fastened of the carrier vehicle to prevent shifting, crushing, or bumping during transport.

Attachment H

Attachment H

Survey of Transfer Route

SURVEY OF TRANSFER ROUTE

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-017
ACDR Subtask 8
Revision 0

September 2000

prepared by

HND TEAM

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Revision 0

September 2000

Prepared by: Chip Conselman, P.E.

Approved by: RL Fritz
Robert L. Fritz

Date: 9-30-00

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Appendices

Tables

Figures

Acronyms

ACD	Advanced Conceptual Design
FFS	Fluor Federal Services
HLW	High-Level Waste
LAW	Low-Activity Waste
SSC	Systems, Structures, and Components
WFD	Waste Feed Delivery
WTF	Waste Treatment Facility

1.0 INTRODUCTION

Project W-521, Waste Feed Delivery System, is installing four waste transfer lines between the AP farm and the tie-in point to the Waste Treatment Facility (WTF). These consist of two low-activity waste (LAW) and two high-level waste (HLW) lines.

During the conceptual design phase of the project, a site development plan was prepared to address the location of eight specific project systems, structures, and components (SSCs). The main purpose of this plan was to develop and maintain a plan that would provide a basis for site development associated with the project scope.

While preparing the site development plan, it was decided that a survey should be performed of the chosen route for the transfer lines to the WTF during the Advanced Conceptual Design (ACD) phase of the project. This would provide further refinement of the chosen path prior to the start of definitive design and validate the estimated quantities of earthwork identified in the conceptual estimate.

1.1 Purpose

The purpose of this task was to evaluate the route chosen for the transfer lines between the new 241-AP-A valve pit and the WTF and to confirm the routing and assure that it is the optimal path.

1.2 Scope

The main focus of this task was to perform a preliminary route survey of the transfer line corridor chosen during the conceptual design phase. The transfer lines that will be located within this corridor are: 3-in. HLW-700, 3-in. HLW-701, 3-in. LAW-702, 3-in. LAW-703.

The preliminary route survey will be used to: 1) find the optimum combination of alignment and grades along the chosen route, 2) avoid any existing physical obstructions, such as the 216-A-29 ditch and 3) adjust (if required) the CDR cost estimate for earthwork quantities.

A surveying and sampling plan was also developed for the entire W-521 Project. This document lays out a strategy for further defining the locations for specific SSCs needed to implement the Waste Feed Delivery (WFD) mission. It provides further refinement of and will be used in conjunction with HNF-5371, *Site Development Plan for Project W-521*, and is provided as Appendix A of this report.

2.0 METHODOLOGY

Prior to performing this route survey, additional field walks and reviews of historical documents (drawings) were performed to determine if any previously unidentified interferences exist. The Site Development Plan for Project W-521, HNF-5371, was reviewed for any other useful information. Obstructions or inconsistencies found by the route survey will be investigated during definitive design by use of potholing, ground-penetrating radar scans and further document searches.

3.0 ASSUMPTIONS

The following assumptions were made:

- The new transfer line route can utilize the existing grout transfer line berm and that the grout transfer line piping can be cut and abandoned in place,
- The new transfer line route can go through the existing grout wastewater trench,
- Existing power poles can be relocated as needed,
- Existing wells can be relocated or modified as needed, and
- The method used for calculating the elevation at the tie-in points for the WTF is correct (see Section 4.2).

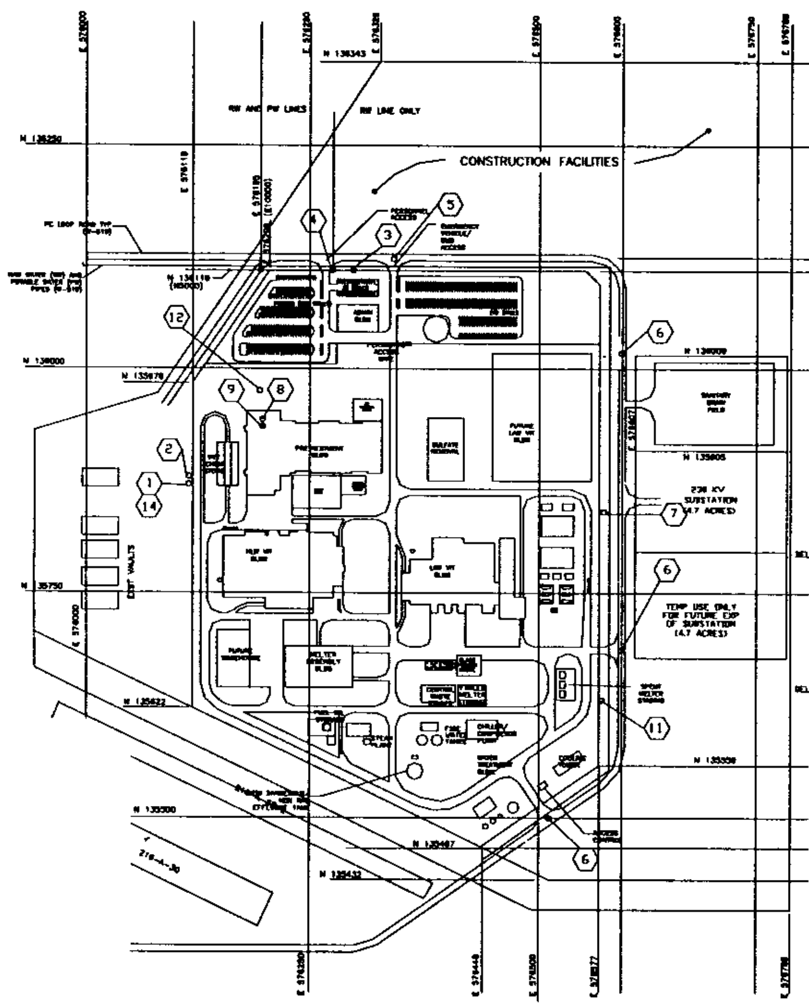
4.0 DISCUSSION

A field walk of the chosen routing was performed on Friday, July 14, 2000. The personnel performing the walkdown were Katie White (CHG), Tom Salzano (ARES), Chip Conselman (ARES) and Dave Fort [Fluor Federal Services (FFS)]. Several small items were noted that could slightly alter the route. An unmapped underground contamination area exists just north of the existing berm for the grout feed line. Several electrical power poles may also cause slight adjustments in the routing. Other than these items, the selected route appears to be acceptable.

A further in-depth review of historical documents (drawings) was performed to confirm that no undiscovered interferences exist. This review did not identify any further unknown obstructions.

The location of the new 241-AP-A valve pit was established (see ESW-521-S2) so that the transfer line tie-in coordinates could be shared with Project W-314, which is in the definitive design phase.

The route survey was performed by FFS. An approximately 50 ft. wide corridor was surveyed, using 1 ft. contour intervals and following the selected route as closely as possible. This survey uncovered several potential areas of concern. The biggest of these is the location of the tie-in points to the WTF, which were given to the project by WTF personnel. These points appear to fall within the existing entrance ramp to the grout vault facility.



NOTES

1. THE PHYSICAL LOCATION OF THE INTERFACE CONTROL POINTS BETWEEN THE RPP-WTP AND DOE/ DOE CONTRACTORS ARE IDENTIFIED AS NODE POINTS.
2. LOCATIONS OF THESE NODES ARE IDENTIFIED IN TWO COORDINATE SYSTEMS.
   a) THE WASHINGTON STATE GRID COORDINATES ARE SHOWN AS N138110. ELEVATION ARE SHOWN AS 204. UNITS ARE IN METERS.
   b) THE RPP-WTP COORDINATES ARE SHOWN AS(N5000) ELEVATIONS ARE SHOWN AS (669.29). UNITS ARE IN FEET.

NODE	TCM	DESCRIPTION	COORDINATES NORTH	COORDINATES EAST	ELEVATION
1	19	LOW ACTIVITY WASTE (LAW) FEED LINE	N135977.13 (N4230)	E578114.84 (E9737)	TBD
2	20	PRELIM	N135978.38 (N4240)	E578114.84 (E9737)	TBD
3	01	RAW WATER PIPING FIRE SUPPRESSION	N136110 (N5000)	E578200 (E10341.21)	201.2 (660.11)
4	02	POTABLE WATER PIPING	N136110 (N5000)	E578275 (E10284.47)	201.01 (661.45)
5	12	PLANT ROAD, NORTH ENTRANCE	N136120 (N5032.81)	TBD	TBD
6	12	PLANT ROAD, EAST ENTRANCE	TBD TBD	E578505 (E11312.34) TBD	TBD TBD
7	11	13.8kv - DUCT BANK INTERFACE CABLE INTERFACE (SWITCH GEAR)	N135835 (N4097.77) TBD	E578500 (E11263.12) TBD	TBD TBD
8	06	RADIOACTIVE, DANGEROUS LIQUID EFFLUENT DN100 IN DN200 ENCASEMENT DN75 IN DN150 ENCASEMENT (BACK UP)	N135941 (N4445.54) N135942 (N4448.82)	E578105 (E10000) E578105 (E10000)	204 (669.29)
9	05	NONRADIOACTIVE, NONDANGEROUS LIQUID EFFLUENT	N135940 (N4442.26)	E578105 (E10000)	204 (669.29)
10	01	RAW WATER FEED TO FLUSH TANK FIRE SUPPRESSION	N135813 (N4025.98)	E575632 (E8152.89)	297 (678.13)
11	01	RAW WATER PIPING - FIRE SUPPRESSION	N135830 (N3423.29)	E578575 (E11240.72)	204.2 (669.95)
12	11	CONSTRUCTION POWER	N135974 (N4553.81)	E578102 (E9990.16)	ON POLE
13	11	BST POWER	N135815 (N4032.15)	E575624 (E8126.84)	GRADE
14	16	ENTRAINED SOLIDS PRELIM	SAME AS NODE 1	SAME AS NODE 1	SAME AS NODE 1

Figure 4-1. WTF ICD SK-W375BF-C00001.

4.1 Horizontal Survey Datum

The coordinates for these tie-in points were given to the project via an Interface Control Drawing (SK-W375BF-C00001, Rev. E). See Figure 4-1. This document references two different horizontal survey datums, the Washington State Grid datum and the WTF datum. These were then converted to the Hanford 200E Plant datum, since this is the datum used by this project. These coordinates are given in Table 4-1.

Table 4-1. Horizontal Survey Datum

DESCRIPTION	HANFORD 200E PLANT COORDINATES (FEET)	WASHINGTON STATE GRID COORDINATES - WCS83S (1991) (METERS)	WTF COORDINATES SK-W375BF-C0001 Rev. E (FEET)
HLW FEED INTERFACE	40557.82 45204.82	N135847.87 E576114.84	N4140 E9737
LAW FEED INTERFACE	40553.81 45204.83	N135846.65 E576114.84	N4136 E9737

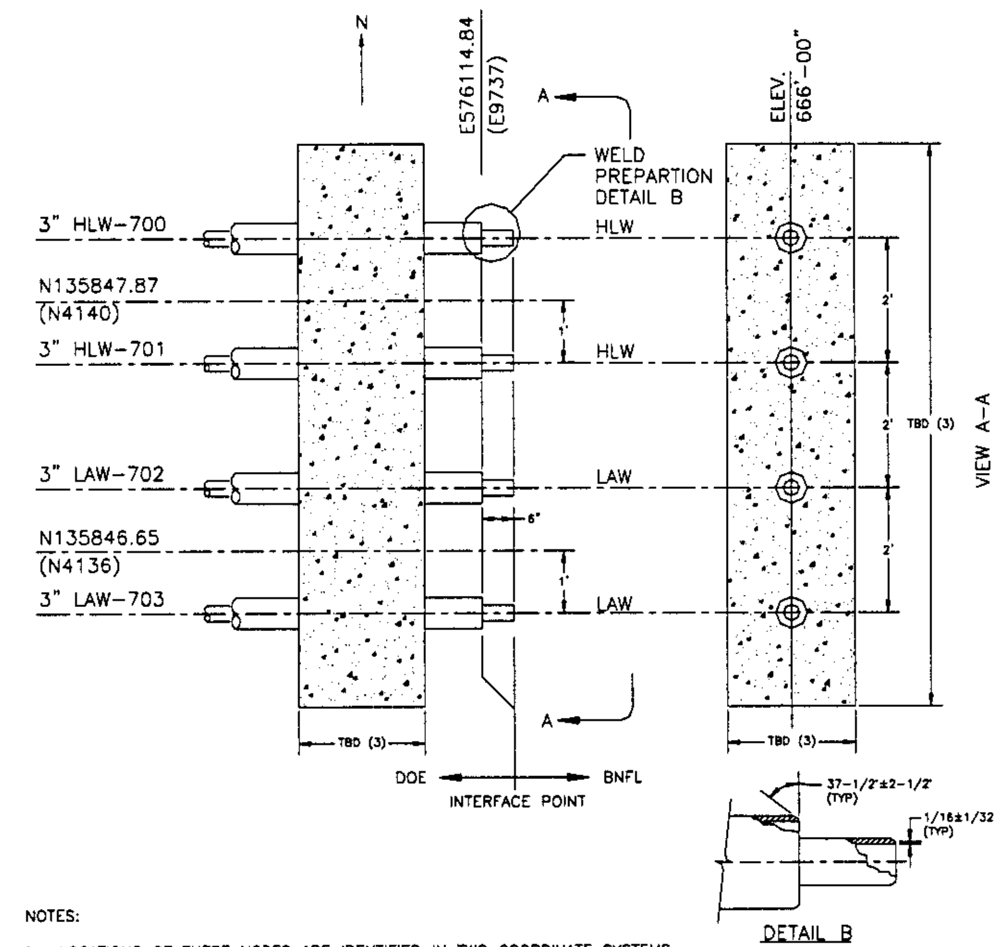
4.2 Vertical Survey Datum

The elevation at the tie-in points was given to the project via ICD No. 19 and 20. See Figure 4-2. It was given as 666.00 ft. and was stated to be in the RPP WTF system. In order to correlate this to a known vertical datum, the Interface Control Drawing (SK-W375BF-C00001, Rev. E) was reviewed against the W-519 design drawings. It was noted that the elevations for several water line tie-ins correlated with the elevations on the W-519 drawings, which utilize the NAVD88 vertical datum (in meters). The Interface Control Drawing also gives these elevations in feet, using a direct conversion of 3.28084 feet per meter. It can therefore be concluded that the 666.00-ft elevation given is in the NAVD88 vertical datum. Subtracting the 3.56-foot difference that exists between the NAVD88 and the 200E Area vertical datum gives an elevation of 662.44-ft. for the tie-in points in the Hanford 200E vertical datum (feet).

Table 4-2. Vertical Survey Datum

DESCRIPTION	HANFORD 200E VERTICAL DATUM (FEET)	NAVD88 (METERS) (FEET)	WTF SYSTEM (ICD NO. 19 & 20) (FEET)
HLW / LAW FEED INTERFACE	662.44	203.00 666.00	666.00

The results of the survey are reflected on ESW-521-C3 and C4.



NOTES:

1. LOCATIONS OF THESE NODES ARE IDENTIFIED IN TWO COORDINATE SYSTEMS.
   a) THE WASHINGTON STATE GRID COORDINATES ARE SHOWN AS N136100. ELEVATIONS ARE SHOWN AS 204. UNITS ARE IN METERS.
   b) THE TWRS-PRIVATIZATION PROJECT PLANT COORDINATE SYSTEMS ARE SHOWN AS (N5000). ELEVATIONS ARE SHOWN AS (669.29). UNITS ARE IN FEET.
2. ADDITIONAL DETAILS SHOWN ON TBD.
3. THE ANCHOR WILL BE SIZED TO ANCHOR LOADS TRANSMITTED FROM BOTH SIDES.
4. NO LOADS FROM DOE WILL BE TRANSMITTED BEYOND THE INTERFACE POINT.

ANCHOR LOADS
(SEE NOTE 4)

	FORCES (lb_f)			MOMENTS (Ft – lb_f)		
	Fx	Fy	Fz	Mx	My	Mz
DOE	TBD	TBD	TBD	TBD	TBD	TBD
BNFL	TBD	TBD	TBD	TBD	TBD	TBD

RPP/BNFL, INC.
PHYSICAL INTERFACE
ICD NOS. 19 (LAW)
AND 20 (HLW)

PCInterface.dwg

Figure 4-2. WTF ICD No. 19 and 20.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Most of the potential obstructions and areas of concern involving the chosen route are relatively minor and can be easily corrected or avoided. This includes fences, power poles and wells. However, the location of the tie-in points to the WTF needs to be addressed. Once it was discovered that these points fall within the grout vault entrance ramp, the CHG project engineer was contacted and told of the situation. The HND Team was asked to choose a location that would be more feasible. The chosen location would be approximately 100-ft north of the existing site, which was the initial site that was given to the project during the CDR stage.

The route indicated on ESW-521-C3 and ESW-521-C4, sheet 1 is the most favorable one for the new transfer lines, with the exception of the location of the tie-in points to the WTF. The coordinates for the new 241-AP-A valve pit are shown on ESW-521-S2, sheet 1. The potential resultant changes to the W-521 estimate are very minor. Dependent upon the resolution of the interface point, assuming the interface coordinate is accurate, minimal changes to the cost estimate will occur (slight increase in backfill at tie-in point, but well within contingency allocation). If the interface point is moved north as proposed, a significant reduction in the W-521 cost for piping, excavating, etc. will result (estimated at up to \$.5M). Until such time as resolution is achieved, this savings has not been included in the cost data for trending the W-521 estimate.

5.1 Cost Summary

No changes to the cost baseline have currently been identified. If, however, the tie in coordinates are relocated as proposed, approximately \$400,000 can be removed from the W-521 estimated due to a reduction in piping lengths.

6.0 REFERENCES

HNF-5371, *Site Development Plan for Project W-521*, HND Team for CH2M Hill Hanford Group, Inc., Richland, Washington.

Appendix A
Surveying and Sampling Plan
Project W-521, Waste Feed Delivery Systems

SURVEYING AND SAMPLING PLAN FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD, INC.
Contract No. 4412 - Release 46
Report No. 990920203-003
Revision 0

July 2000

prepared by

HND TEAM

SURVEYING AND SAMPLING PLAN FOR PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD, INC.

Contract No. 4412 - Release 46
Report No. 990920203-003
Revision 0

July 2000

Prepared by: Chip Conselman, P.E.

Approved by: ____________________
Robert L. Fritz

Date: ____________________

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Tables

Acronyms

ACD	Advanced Conceptual Design
ARES	ARES Corporation
CHG	CH2M HILL Hanford Group, Inc.
DD	Definitive Design
GPR	Ground Penetrating Radar
HLW	High-Level Waste
ICE	Instrument, Control, and Electrical
LAW	Low Activity Waste
SSC	Systems, Structures and Components
WFD	Waste Feed Delivery
WTP	Waste Treatment Plant

1.0 INTRODUCTION

The purpose of establishing this Surveying and Sampling Plan is to develop a strategy for further defining the locations for specific Systems, Structures and Components (SSC) needed to implement the Waste Feed Delivery (WFD) mission. It provides further refinement of and will be used in conjunction with HNF-5371, *Site Development Plan for Project W-521.*

The specific Project W-521 SSC being addressed by this plan are:

- The new 241-AP-A valve pit within the 241-AP Tank Farm,
- The new transfer lines (3-in. SN-640 and 3-in. SN-641) between the existing 241-AP valve pit and the new 241-AP-A valve pit,
- The new low activity waste (LAW) and high-level waste (HLW) transfer lines (3-in. LAW-703, 3-in. LAW-702, 3-in. HLW-700, and 3-in. HLW-701) between the new 241-AP-A valve pit and the Waste Treatment Plant (WTP) LAW and HLW interfaces,
- The new Instrument, Control, and Electrical (ICE) Building supporting the 241-AW Tank Farm,
- The new caustic and diluent addition system supporting the 241-AW Tank Farm,
- The new ICE Building supporting the 241-AY Tank Farm,
- The new ICE Building supporting the 241-SY Tank Farm,
- The modifications and additions to the caustic and diluent addition system supporting the 241-SY Tank Farm, and
- The modifications to the 241-AY/AZ ventilation system.
- Any other SSC, particularly new structures or below grade pipe and conduit runs, on an as-needed basis.

2.0 APPROACH/METHODOLOGY

As part of the continuing W-521 design effort, several of the key project SSC require further review and refinement to confirm that the locations chosen are the most feasible. This process involves several key steps, including:

- Further review of historical documents (drawings, specifications, reports, etc..),
- Additional Field Walkdowns,

- Surveying,
- Subsurface scanning, including ground penetrating radar (GPR), and
- Potholing.

The activities that need to be performed for each of the given SSC are given in Table 2-1. The table also indicates the project phase (advanced conceptual design, definitive design (DD) during which each task is anticipated to be performed.

Table 2-1. Activities Per SSC and Project Phase

SSC	Review Historical Documents	Field Walkdowns	Surveying	GPR Scans	Potholing
241-AP-A Valve Pit	DD	DD	DD	DD	DD
3-in. SN-640 & SN-641 Transfer Lines	DD	DD	DD	DD	DD
3-in. LAW & HLW Transfer Lines	ACD	ACD	ACD/DD	DD	DD
241-AW ICE Bldg	DD	DD	DD	DD	DD
241-AW Caustic & Diluent System	DD	DD	DD	DD	DD
241-AY ICE Bldg	DD	DD	DD	DD	DD
241-SY ICE Bldg	DD	DD	DD	DD	DD
241-SY Caustic & Diluent System	DD	DD	DD	DD	DD
241-AY/AZ Vent System	DD	DD	DD	DD	DD

2.1 Further Review of Historical Documents

This activity involves doing additional drawing and document searches for each of the areas where a Project W-521 SSC is being located and documenting any potential impediments to construction. HNF-2756, P*rivatization Contractor Transfer/Feed Line Corridor Obstructions*, will be used in reviewing the route for the LAW and HLW transfer lines to the WTP. Various data and documents from other projects, such as survey data, subsurface scanning data and soils reports, will be utilized to minimize rework. Projects of particular interest include W-211, W-314, W-519, W-030 and W-058.

2.2 Field Walkdowns

Additional field walkdowns will be completed by members of the design team prior to performing any surveying, GPR scanning or potholing. This step will provide for any fine tuning of the locations prior to surveying. Digital cameras will be utilized to document the existing conditions.

2.3 Surveying

All surveying will performed by a professional land surveyor. This includes preliminary route surveying of transfer line routes in order to find a route that provides the optimum combination of alignment and grades.

2.4 Ground Penetrating Radar Scans

Ground penetrating radar scans will be performed to determine 1) if any unknown underground obstructions exist and 2) the approximate size and depth of both known and unknown underground obstructions.

The majority of the route being used for the transfer lines between the existing and new AP valve pits follows the route initially laid out by W-314 during Definitive Design. Project W-314 documentation will be reviewed to confirm that the proper surveying and scanning were performed.

2.5 Potholing

If uncertainties or concerns still exist after all of the preceding steps have been utilized, potholing will be performed at selective sites.

3.0 REQUIRED RESOURCES

In order to perform all of the steps of this plan in an adequate manner, access to several resources will be required. These consist of:

- Historical documents.
- Services of a professional land surveyor licensed in the State of Washington.
- Services of an organization capable of performing GPR scans.
- Services of an organization capable of performing potholing.

4.0 SCHEDULE

The new LAW and HLW transfer lines between the new 241-AP-A valve pit and the WTP LAW and HLW interfaces will be addressed during the Advanced Conceptual Design (ACD) effort. The remaining SSCs will be dealt with during DD.

5.0 ORGANIZATION AND FUNCTIONAL RESPONSIBILITIES

During the ACD phase, ARES Corporation (ARES) prepared a Statement of Work format for surveying services. ARES also provided oversight of the surveying task performed during the ACD.

The Architect-Engineer performing the DD will be responsible for completing the remainder of the activities given in Section 2.

CH2M HILL Hanford Group, Inc. (CHG) will provide access to or copies of requested historical documents, including drawings, specifications and test reports. CHG will also provide the contracting mechanism for acquiring the services of a professional land surveyor during the ACD phase.

6.0 SUMMARY AND RESULTS

All information gathered throughout this process will be used to refine and improve the W-521 design.

7.0 REFERENCES

Fort, D. and Parazin, R., 1998, *Privatization Contractor Transfer/Feed Line Corridor Obstructions*, HNF-2756, Rev. 0, Numatec Hanford Corporation, Richland, Washington.

HND Team, 2000, *Site Development for Project W-521 Waste Feed Delivery Systems*, HNF-5371, Rev. 1, CH2M Hill Hanford Group, Incorporated, Richland, Washington.

Attachment I

Attachment I

Distribution of Mixer Pump Power

DISTRIBUTION OF MIXER PUMP POWER

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-011
ACDR Subtask 9
Revision 0

September 2000

prepared by

HND TEAM

DISTRIBUTION OF MIXER PUMP POWER

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46
Report No. 990920203-011
ACDR Subtask 9
Revision 0

September 2000

Prepared by: Richard L. Golberg, P.E.

Approved by: RLFritz
Robert L. Fritz

Date: 9-30-00

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Tables

Acronyms

ECN	Engineering Change Notices
HLW	High-Level Waste
LAW	Low-Activity Waste
VFD	Variable Frequency Drives
WTF	Waste Treatment Facility

1.0 INTRODUCTION

Project W-521, Waste Feed Delivery Systems, is installing mixer pump at various locations in the 200 West Area and the 200 East Area. These pumps will support line flushing for low activity waste (LAW) and high-level waste (HLW) transfers including intra-farm transfers, inter-farm transfers, and transfers to the Waste Treatment Facility (WTF). The major components of these systems consist of associated support equipment, a static mixing tee, a mixing and storage tank, supply pumps, valves, piping, and instrumentation used for monitoring and control.

During the conceptual design phase of the project, various questions and concerns were raised about the capabilities and layout of the mixer pump power distribution. Also, since preparation of the CDR, numerous changes have been made to the requirements contained in the Level 2 specification, HNF-4164, *Double Shell Tank Mixer Pump Subsystem Specification*. In order to address these items, this report was developed to evaluate power distributions with respect to mixer pump operation.

1.1 Purpose

The purpose of this task was to investigate options for providing 480 V electrical power from the Variable Frequency Drives (VFD) in the 241-AY, 241-AW and 241-SY ICE Buildings to the tank mixer and transfer pumps. The current W-521 conceptual design has the power being routed to the first tank in a given farm where pumps (mixer pumps and a transfer pump) is scheduled to be installed. Double throw, three pole transfer switches are then installed at this tank to provide for selecting either the first tank's pumps or the next scheduled tank with pumps being installed. Double throw, three pole transfer switches are then installed at the second tank to provide for selecting either the second tank's pumps or the third tank with pumps being installed. This installation allows multiple mixer pumps or transfer pumps to operate from a single variable frequency drive. This is a very cost effective method for meeting the existing criteria for only two 300 HP mixer pumps and one 60 HP transfer pump running at any time in a tank farm. The current project schedule has changed several times, affecting the order of the tank mixer pumps and transfer pump installation, and thus the effectiveness of this type of an installation. This report evaluates more flexible, less expensive options to distribute this power, while maintaining the ability to meet the technical criteria previously established.

1.2 Scope

The designs for the 241-AY, 241-AW and 241-SY tank farm power systems were reviewed, looking for ways to improve the flexibility, cost, and schedule of the system. Considerations were given to potential schedule changes, cabling costs, excavation costs, operation entrance into the farm, and other construct ability/maintainability issues.

2.0 METHODOLOGY

The current CDR Design was established as the baseline alternatives were compared against this baseline from, primarily, a cost perspective. Since no alternatives were considered which did not meet all technical, environmental, and safety requirements, the lowest cost option will be preferred alternative.

The two alternatives that were considered included:

- Radial power supplied from a centralized power island to the tanks requiring mixer and transfer pumps, and
- Use of power panels with keyed interlocking breakers.

3.0 ASSUMPTIONS

The current project schedule has changed several times, affecting the order of the tank mixer pumps and transfer pump installation. Currently, continued schedule changes would require Engineering Change Notices (ECNs) to be written to change the design to reroute the power for the pumps to the first tank scheduled for pump installation. This redesign would be necessary to accommodate the construction sequence, while supporting operational needs. It is assumed that continued scheduled changes will occur and that the selected alternative mush be more flexible than the current configuration. It is also assumed that only two mixer and one transfer pump will be required to operate simultaneously in any given farm.

4.0 DISCUSSION

The existing conceptual design baseline and tank farm schedules were evaluated and compared against a centrally located power island with two 600 A, 480 V, 3 phase power panels. Each panel would be provided with three keyed interlocking breakers to select the mixer pump in the tank requiring mixing. A 200 A, 480 V, 3 phase power panel, with three keyed interlocked breakers to select the transfer pump in the tank requiring waste transfer would also be provided. The panels with the keyed interlocks were selected as the preferred alternative. The use of panel boards located in a central location each fed from a separate VFD allows selection of the designated tank requiring mixing or transferring. This configuration includes the installation of radial feeds to each tank. This installation can be incorporated into the current or future schedules for installation of the mixer and transfer pumps with no design changes or impact to cost.

This alternative reduces cost (as shown in Table 5-1) provides significant flexibility for schedule changes, and is less maintenance intensive. This alternative utilizes only commercially available equipment, and eliminates the risk associated with the current baseline (600 A double throw transfer switch rated for a 300HP motor is not commercially available without additional testing to meet the NEC requirements). Since the above noted advantages exist, and all technical criteria is met, the keyed interlocked panel alternative is selected.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed layout for the 241-AY, 241-AW and 241-SY will be changed to show a power island in a central location. The 241-AY, 241-AW and 241-SY one line drawings will be revised to show power panels for the mixer and transfer pumps. Drawings ESW-521-E3, E4, E5 and E6 have been revised to show this arrangement.

Using NEMA 3R power panels instead of double throw transfer switches will reduce the material and installation costs of the project. The Level 2 Specification, *HNF 4159 Double-Shell Tank Utilities Specification*, requires that electrical enclosures mounted outdoors be rated NEMA 4. An exception or revision to the specification is required, as many panel boards and transfer switches cannot be obtained in a rated NEMA 4 enclosure, nor is this requirement (as a blanket statement) appropriate. The W-521 design authority is aware of the issue and is pursuing appropriate changes/interpretation of the Level 2 Specifications.

5.1 Cost

The cost reduction to accomplish these additions is shown in Table 5-1.

Table 5-1. Cost

MIXER PUMP POWER UPGRADES - REDUCTION FROM CDR												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$62,720	$15,056	-$24,800	-$2,174	-$2,899	-$1,449	-$725	-$2,174	-$1,449	-$12,190	-$22,088	-$24,121	-$141,733

6.0 REFERENCES

HNF-4159, Rev 0, Double-Shell Tank Utilities Specification.

Attachment J

Attachment J

Vendor Search for Small Camera System

VENDOR SEARCH FOR SMALL CAMERA SYSTEM

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-016
ACDR Subtask 10
Revision 0

September 2000

prepared by

HND TEAM

VENDOR SEARCH FOR SMALL CAMERA SYSTEM

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract 4412, Release 46
Report No. 990920203-016
ACDR Subtask 10
Revision 0

September 2000

Prepared by: Mike Garcia, P.E.
Bruce Groth

Approved by: RLFritz
Robert L. Fritz

Date: 9-29-00

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Acronyms

ACD	Advanced Conceptual Design
CCTV	Closed Circuit Television
DST	Double-Shell Tank
LCCA	Life-Cycle Cost Analysis
MCCS	Mobile Color Camera System
ROS	Remote Ocean Systems

1.0 INTRODUCTION

Project W-521, "Waste Feed Delivery Systems," will upgrade systems, structures, and components at eight double-shell tanks (DST) as necessary to assure successful and reliable Phase 1 waste feed delivery to the Waste Treatment Facility. The eight DSTs included in Project W-521 are AW-101, AW-103, AW-104, AY-101, AY-102, SY-101, SY-102 and SY-103. Although the scope of this document addresses Project W-521 DSTs, there is a direct application to other tanks and projects.

1.1 Purpose

The purpose of Advanced Conceptual Design (ACD) on any project is to allow an opportunity to address uncertainties remaining from the Conceptual Design Phase. These uncertainties may be in the technical, cost or schedule arenas, and the focus may be on either confirmation of concepts or improvement of concepts. ACD on project W-521 will focus primarily on improvement of concepts which will potentially result in lower cost alternatives, better operability, or reduction in schedule.

1.2 Scope

As part of this effort, Closed Circuit Television (CCTV) systems will be assessed to determine the most cost effective approach for meeting the functional needs of the W-521 project. There are a number of existing camera systems currently in use in the tank farms. Some of these systems may or may not be useful due to the requirements and constraints of the W-521 project. Several issues on CCTV configuration that affect reliability, operability, and maintainability need to be addressed.

2.0 METHODOLOGY

This document identifies requirements and constraints, determines alternatives to meet these requirements, and generates recommendations of the selected alternative for meeting the requirements while attempting to meet other goals that have been identified. The principal decision making tool will be a life-cycle cost analysis (LCCA).

3.0 ASSUMPTIONS

Several assumptions are made in this document concerning the operating duty cycle needed for the CCTV systems. Because of this, the LCCA performs a break-even analysis based on the number of weeks a year a given camera system may be used. It is also assumed that the operating environment will be similar from tank to tank for purposes of determining maintenance costs.

4.0 DISCUSSION

4.1 Principle Issues

Some of the principal issues that have brought the CCTV systems to the point of being considered in this study include:

- Early camera systems used in the tank farms required 12-in. and larger risers for installation into the tank.
- Cameras that have been designed for installation in risers as small as 4-in. have experienced mechanical operating problems.
- It is uncertain whether a "permanent" CCTV system, or a mobile or temporary CCTV system is more cost effective.
- Cameras that have been designed for installation in risers as small as 4-in. have inadequate lighting for viewing all features within a tank.

4.2 CCTV Requirements

The requirement for having a CCTV system is contained in section 3.7.2 of HNF-4155 (CHG 2000). However, this document contains very few requirements that the CCTV system will have to meet. Therefore, additional documents were reviewed for requirements that would be applicable to the CCTV system. These requirements include functional requirements, environmental conditions, and physical interface requirements. In certain cases, assumptions were made that will need to be validated as the project progresses. These assumptions are clearly noted by placing a **<TBR>** which means "to be reviewed."

Table 4-1. CCTV Applicable Requirements

Parameter	Requirement	Reference
Functional – Monitor in-tank waste action	The crust in Tanks 241-AN-103, -104, -105, 241-AW-101, and 241-SY-103 are 1 ft to 3 ft thick and have the potential to cause structural damage to the tank walls, floors, and in-tank components when liquid is removed from beneath them. The crust behavior could potentially be monitored by CCTV. Hold points in these cases should be a part of the process control strategy during supernatant removal.	HNF-5146, rev. 0, Appendix D, Issue 10 (Staehr 2000a)
Functional – Monitor aging waste in-tank equipment	The aging waste tanks contain several components that are supported from the tank dome and hang in the tank. These components include ALCs, dry wells, thermocouple assemblies, and a steam coil assembly. The process control strategy for ensuring the integrity of in-tank components during mixer pump operations will be to monitor component deflections using a closed-circuit television, and then to compare the readings to calculated allowable values.	HNF-5145, rev. 0, section 3.2.3.2 (Staehr 2000b)

Parameter	Requirement	Reference
Flammable Gas Controls	The surface temperature of heat-generating devices shall not exceed 780 degrees F. The surface temperature is limited to a maximum of 320 degrees F if the device can contact the waste and cause ignition by triggering exothermic reactions in the waste. Internal temperatures of heat-generating devices may exceed these temperatures (NFPA 70, Articles 500 and 501) if the heat source is either isolated (pressurized) from the gas environment, or if the design of the device enclosure meets the requirements for explosion-proof housings.	HNF-SD-WM-TSR-006, rev. 1, section 5.10.2.c.4 (Jones 1999)
Flammable Gas Controls	Electrical equipment shall be designed to meet NFPA 70, Class I, Division I, Group B criteria or provide equivalent safety. As a minimum, this shall be interpreted to mean that no single point failure of energized equipment can result in an arc, spark, or gas burn propagation to the environment external to the source enclosure (NFPA 70).	HNF-SD-WM-TSR-006, rev. 1, section 5.10.2.c.5 (Jones 1999)
Flammable Gas Controls	Shutdown of purged and pressurized electrical equipment, and purged and pressurized heat-generating equipment, on loss of protective gas pressure or flow, shall be automatic by design as defined by NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment,* Type X pressurization.	HNF-SD-WM-TSR-006, rev. 1, section 5.10.2.c.6 (Jones 1999)
Flammable Gas Controls	Interlocked startup of purged and pressurized electrical or purged and pressurized heat-generating equipment shall only be allowed when the system senses preset limits (e.g., adequate protective gas pressure established as defined by NFPA 496). If pressurized enclosures are used to isolate energized components, a minimum of four enclosure volumes shall be purged through the enclosure for energized components, and/or ten volumes shall be purged for enclosed motors before controlled startup of the system components (NFPA 70, NFPA 496).	HNF-SD-WM-TSR-006, rev. 1, section 5.10.2.c.7 (Jones 1999)
Environment: Temperature	Maximum waste temperature is 195 degrees F. Existing cameras are rated to 176 degrees F. with the purge system operating. Actual temperatures in the vapor space aren't completely known but will likely be 176 degrees F or less so we will assume this requirement is conservative. **<TBR>**	HNF-SD-WM-TSR-006, rev. 1, section 3.3.2 (Jones 1999)
Environment: pH	Vapor space pH is unknown, but designing for a pH of 13 as was done in 106-C (WHC-S-0439) is relatively simple and yet conservative. Waste pH ranges from 12 to 5.6 M NaOH. **<TBR>**	WHC-S-0439 sec. 4.0.f (Pedersen 1995)
Pan and Tilt	Pan and tilt is required for viewing of entire tank from one location. 350 degree revolution horizontal, straight down to 60 degrees above horizontal.	Various past camera specifications
Riser Length	Typical DST riser for a camera is around 13-14 feet. This will be addressed on a case by case basis due to differences in available risers.	Drawings H-2-71996, and H-14-010501.

Parameter	Requirement	Reference
Riser Diameter	Varies. In most cases only a 4-in. diameter riser is available. In some cases a 12-in. or larger diameter riser may be available, but use of a 4-in. riser is preferred.	RPP-6333 (CHG 2000c)
Duty Cycle	For staging tanks, the most likely duty cycle for the CCTV system is in support of batch transfers of 100,000 gallons. The tank would first be mixed for a period of 1-2 weeks and then the waste transferred at approximately 100 gpm (this equates to 17 hours). There would then be a down time of up to one month before the next transfer. For non-staging tanks, the duty cycle for the CCTV system is in support of a continuous transfer instead of 100,000 gallon batches.	Discussions with Bill Powell (design authority)
Calibration	The CCTV system must be capable of being calibrated to measure deflection of in-tank equipment.	HNF-5146, rev. 0, Appendix D, Issue 10 (Staehr 2000a) and HNF-5145, rev. 0, section 3.2.3.2 (Staehr 2000b)

4.3 CCTV Goals

In addition to the requirements and constraints, several other parameters have been identified that could assist in determining the preferred alternative. For most of these goals it is difficult to assign a minimum or maximum value to them, but it is possible to subjectively compare performance between the alternatives. These goals are:

- Minimize life-cycle costs (includes capital costs, operating costs, and maintenance costs).
- System reliability (this will be assessed by using the life-cycle costs).
- Lens flushing system. Although not required for all applications, it may be a beneficial capability. Required in tanks being sluiced.
- Zoom capabilities. Existing cameras have zoom lenses from 4:1 up to 8:1.
- Radiation Resistance/Life Expectancy (this will also be assessed by using the life-cycle costs). The design radiation field is 200 r/hr (WHC 1996), although 101-AZ tank has seen radiation fields of around 1,000 r/hr.
- Resolution. Existing cameras have resolutions of up to 1/32-in. wide line on a medium gray card at a distance of 40 ft. and a 1-in. black square on a medium gray card at a distance of 65 ft. using light supplied only be the video system lamp (Shumake 1999). This high of a resolution will not be required to monitor general movement of waste and equipment in the tanks.

4.4 Description of Existing Camera Systems And Infrastructure

Although cameras have been used in the Hanford waste tanks in the more distant past, the current generation of explosion proof cameras was first installed in tank 101-SY in 1991. These cameras were relatively prototypic and numerous improvements and refinements have been made in these essentially 'permanent' cameras. In addition to these permanent cameras, a temporary or portable camera system known as the Mobile Color Camera System (MCCS) was developed which was capable of being installed down in 4 in. riser, and was principally used by the characterization program to view core sampling operations.

At this time there are three main camera systems available for use in the Hanford tank farms. All are approved for use in a Class 1, Division 1, Group B hazardous environment as defined in the National Electric Code (NFPA 1999). The three systems are:

- A permanent system designed to fit down a 12-in. or larger diameter riser. The purge system and monitor system infrastructure are designed to be permanently installed in the tank farms. This system is noted for comparison purposes with the 4-in. permanent system.
- A permanent system designed to fit down a 4-in. or larger diameter riser. The purge system and monitor system infrastructure are designed to be permanently installed in the tank farms.
- A temporary MCCS designed to fit down a 4-in. or large diameter riser. The purge system and monitor system infrastructure are mounted in a panel truck, or in some cases, local instrument air is used for the purge.

A more detailed description of each of these systems follows.

4.4.1 12-Inch Permanent System

This permanent system was installed in tank 241-C-106 for the sluicing operation and is designed to fit down a 12-in. or larger diameter riser. The purge system and monitor system infrastructure are designed to be permanently installed in the tank farms. This system has had a good working history and is sturdier than the 4-in. systems. The system is fully described in Vendor Information file 22668, supplement 105.

Most of the requirements defined from previous camera usage at the tank farms can be met with this system. The purge gas control system was not originally required for this camera, although it originally had a dry air system on it to prevent condensate from building up. Subsequent retrofit of the system resulted in a temperature rating of the in-tank components at 176 deg. F with the purge gas flow. This system has a radiation tolerance of 4.2×10^6 rad cumulative for 0.67 MEV gamma which is approximately 2.5 years in a 200 r/hr field. The lighting on this system is enough to not only provide excellent imaging at 60 ft but to observe the characteristics and behavior of the tanks with four 250W quartz halogen lamps. The zoom capability is 4:1 as compared to some other systems, which are 8:1. Since the camera was used in the sluicing operation, there is a light and lens flushing system. The necessity of flushing for mixing and pumping operations would determine the usefulness of this feature for other tanks. A schematic of the system is shown as Figure 4-1.

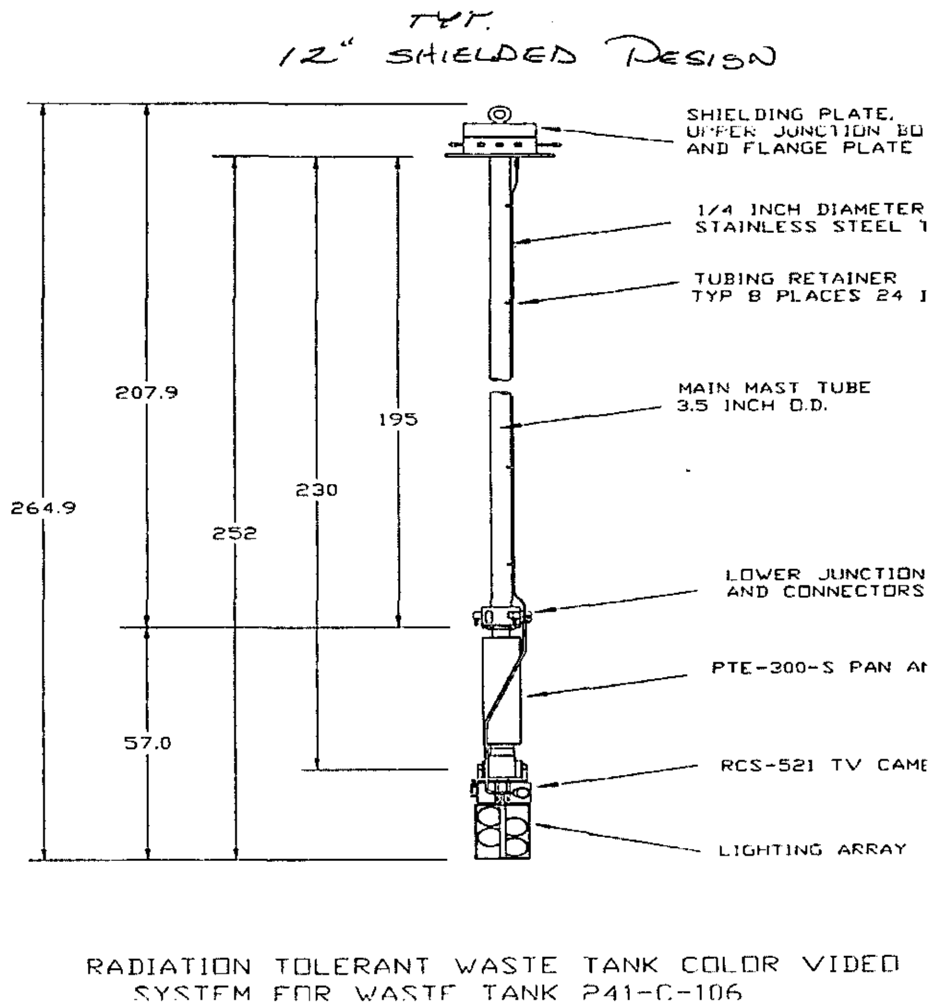


Figure 4-1. 12-Inch Permanent Camera.

4.4.2 4-Inch Permanent System

This permanent system was installed in tank 241-AZ-101 and was designed to fit down a 4-in. or larger diameter riser. The purge system and monitor system infrastructure, are designed to be permanently installed in the tank farms. The system is fully described in Vendor Information file 22515, supplement 44.

The system is designed for the purge function and has a desiccant air dryer on it. The lighting uses two 75-watt halogen lamps. There is some concern that this may not be enough illumination for characterization or component deflection measuring, even though it is adequate for basic camera resolution. The radiation exposure limit is somewhat reduced from the 12-in. system although adequate for normal inspection. The camera is fully shielded and the manufacturer has estimated that the conservative lifetime accumulated dose is 2.3×10^6 rad cumulative for 0.67 MEV gamma. The temperature rating of the camera with the purge gas flow is 176 deg F. The zoom capability 4:1 as compared to some other systems which are 8:1. It is designed for automatic shutdown in case of the loss of purge gas. There currently is no requirement for a light/lens flushing system on either of the 4-in. riser systems. Zoom, pan and tilt functions are virtually the same for both 4-in. systems. They both are capable of panning 60 deg above horizontal. A schematic of the system is shown as Figure 4-2. During the AZ-101 Mixer Pump Test, the camera provided excellent data. The expected life of the camera was predicted to be 2000 hours. As the camera was being panned, it was bumped into a thermocouple installed in riser 168. The camera was removed, repaired, and returned to service. The camera failed for the record and last time three weeks after it was initially put into service. It was thought that the camera failed due to moisture accumulation in the mast assembly. Reference RPP-6548, Rev. 0, *"Preliminary Test Report 241-AZ-101 Mixer Pump Test,"* (CHG 2000b).

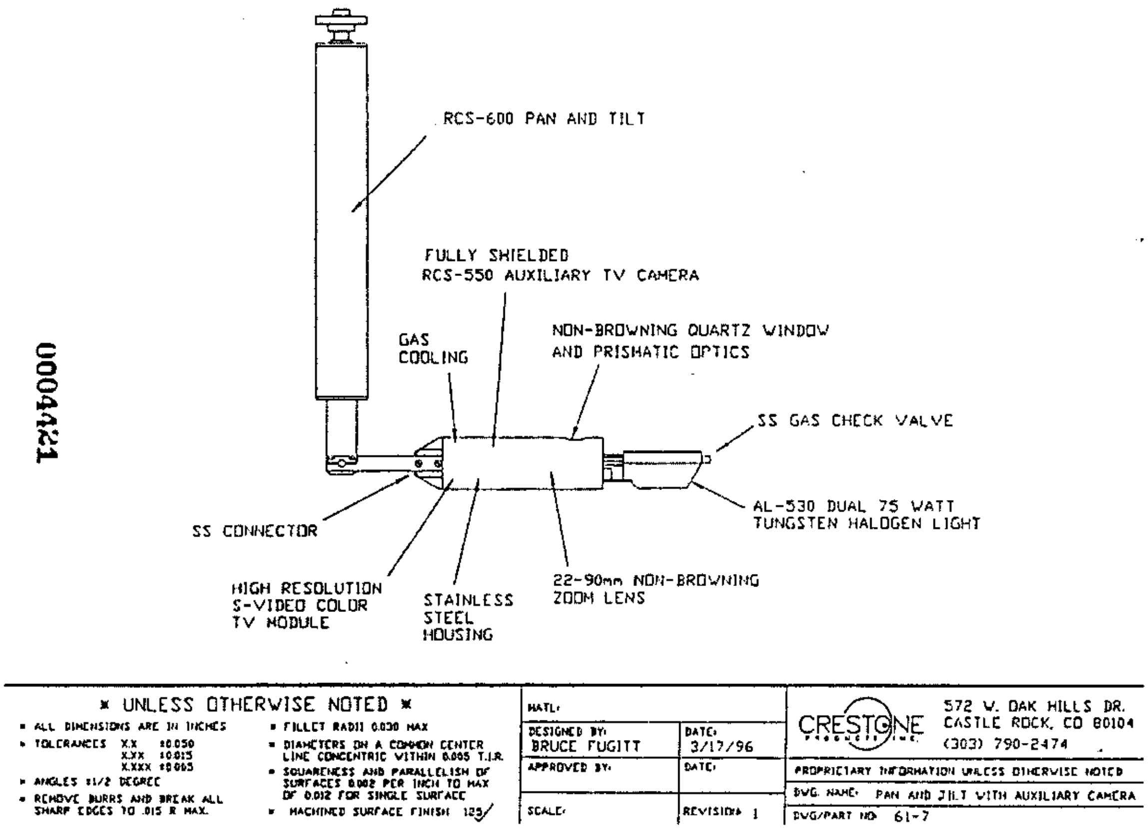


Figure 4-2. 4-Inch Permanent Camera System.

4.4.3 4-Inch Mobile Color Camera System (MCCS)

The MCCS is temporary camera system designed to fit down a 4-in. or larger diameter riser. The purge system and monitor system infrastructure are mounted in a panel truck, or in some cases, local instrument air is used for the purge. Basically, the mobile purge system works the same as the permanent 4-in. camera and will shut down the system in the event of pressure loss. There are no requirements for light/lens flushing. The system is fully described in Vendor Information file 22728, supplement 1.

This system is non-shielded which ultimately causes the camera to malfunction in a relatively short amount of time when exposed to a radiation field. It will function in 200 rad/hr environment but is only rated at 10,000 rad of cumulative radiation or 50 hours of operation. Multiple cameras would be necessary for any lengthy mixing and pumping operations. The system can be installed and removed in approximately half a shift by a crew of operators without the use of a crane or other hoisting device. There is only one 75W halogen lamp on this system, which may not be enough for quality image resolution at 60 ft. The addition of a separate light through a different riser would need to be considered especially for waste monitoring and characterization. The zoom capability of the MCCS is 8:1. The camera is designed to withstand a pH of between 8 and 14, which meets the tank environmental compatibility requirement. A schematic of the system is shown as Figure 4-3.

4.5 CCTV Alternatives Assessment

4.5.1 Determination of Alternatives

All existing systems at the Hanford site tank farms were considered as options. In addition, improvements that could be made to these systems to meet requirements and goals, or reduce life-cycle costs were noted. A search for additional vendors was also conducted using such sources as the internet, interviews with other engineers, *Nuclear News Buyer's Guide*, and the *Thomas Register*. The existing CCTV systems in the tank farm were all designed and fabricated by R.J. Electronics who has also supplied camera systems in use in the K-Basins. Most camera vendors clearly did not have a system to meet the restrictive requirements, and did not have the capabilities or the interest to develop a proper deployment system. It should be noted here that the camera itself is a fairly small percentage of the cost in installing and operating a CCTV system in the tank farms. The main costs are in the system integration necessary to deploy the camera in an explosion proof configuration through as small a riser as possible. Therefore, a small number of camera vendors were chosen for further investigation based on their work in developing whole systems as opposed in simply being a camera vendor. The three vendors chosen were:

- IST Visual Imaging Systems, which recently acquired REES camera, which is a long time supplier of radiation tolerant camera systems,
- Remote Ocean Systems (ROS) which has proposed on Hanford tank CCTV systems in the past, and
- Industrial Video, which developed CCTV systems for nuclear applications.

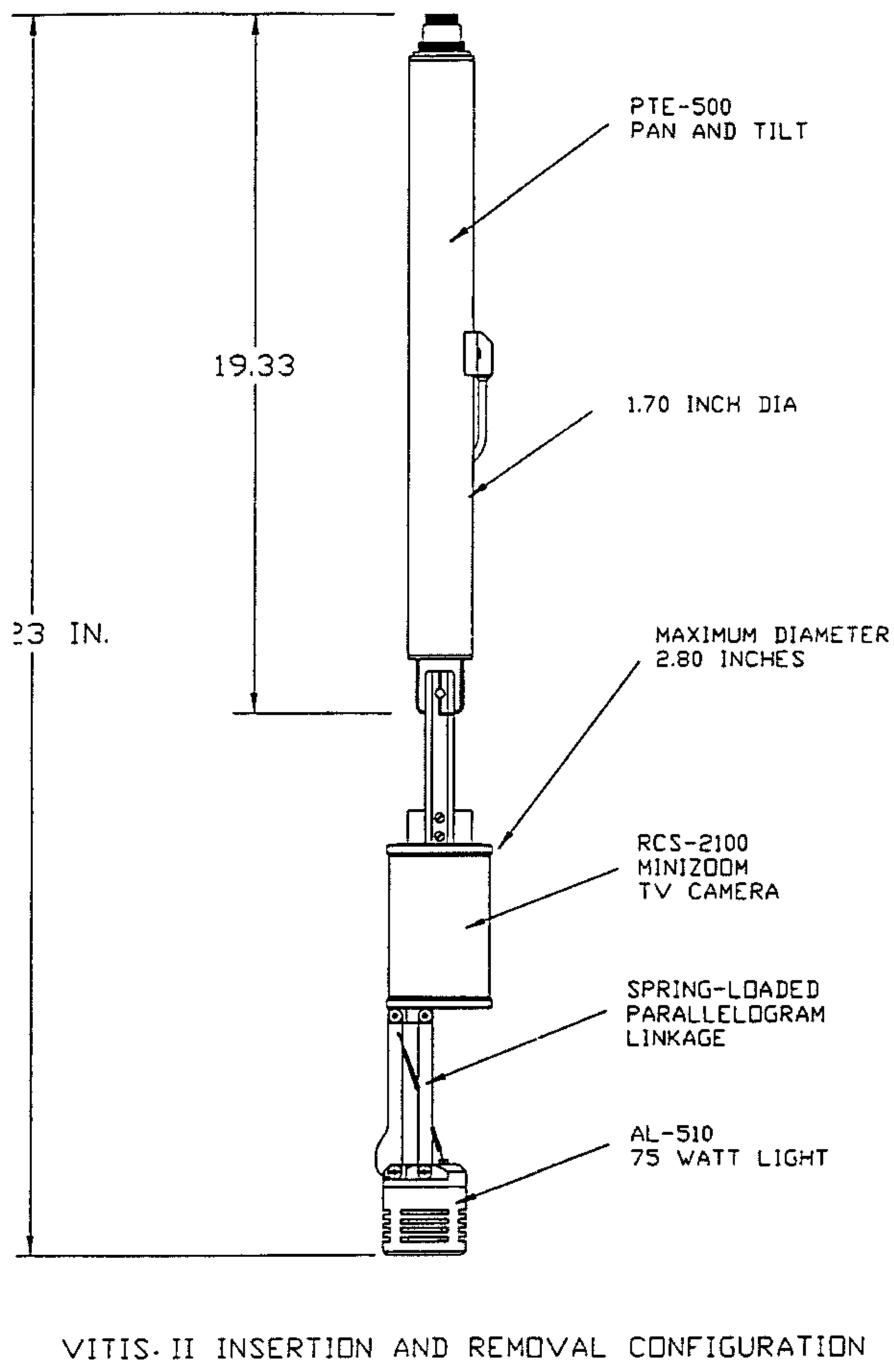


Figure 4-3. 4-Inch MCCS.

The other option would be to work with existing Hanford tank farm CCTV system vendors to utilize cameras from other suppliers and use existing deployment systems that they have developed to gain the advantages of each component.

4.5.2 Evaluation of Alternatives Versus Requirements

Table 4-2 displays a summary of the ability of the existing Hanford Site cameras and ROS and IST cameras to meet the requirements. In all cases this was proposed by installing cameras in purged housings for both cooling and to meet flammable gas control requirements. In discussing options with both IST and ROS, they both stated that all the requirements stated in section 2.0 could not be met with existing designs and equipment, and that a development effort would be needed. ROS expressed no interest at this time in determining what any development effort would entail or cost (Campos 2000). Therefore, the ROS option was ruled out. IST stated they thought they could develop a system for use in a 12-in. or larger riser for a rough order of magnitude cost of $75K, and that each system would cost $40-45K. The IST system would be based on their RC2126 camera system for which a data sheet is contained in Appendix B. For a 4-in. riser, IST thought a system could be developed for $200K, and that each system would cost $80K (Nold 2000). These costs were not used for comparison purposes with existing systems, because a full specification that included QA requirements, documentation requirements, and terms and conditions was not given them. However, it is instructive that another company besides the current vendor may be interested in developing a system. It should be cautioned though that costs as high as two-to-three times those stated are a potential.

Table 4-2. Alternatives Requirements Analysis

Parameter	Existing 'Permanent' 12-in. Camera	Existing 'Permanent' 4-in. Camera	MCCS 4-in. Camera	IST-REES	ROS
Functional – Monitor in-tank waste action	Yes	Yes	Yes	Yes	Yes
Functional – Monitor aging waste in-tank equipment	Yes	Yes	Yes	Yes	Yes
Flammable Gas Controls	Yes	Yes	Yes	Yes	Yes
Flammable Gas Controls	Yes	Yes	Yes	Yes	Yes
Flammable Gas Controls	Yes	Yes	Yes	Yes	Yes
Flammable Gas Controls	Yes	Yes	Yes	Yes	Yes
Environment: Temperature	Yes-with purge system	Yes-with purge system	Yes-with purge system	Yes-with purge system	Yes-with purge system
Environment: pH	Yes	Yes	Yes	Yes	Yes
Pan and Tilt	Yes	Yes	Yes	Yes	Yes
Riser Length	Yes	Yes	Yes	Yes	Yes
Riser Diameter	No	Yes	Yes	No	No
Duty Cycle	Yes	Yes	Yes	Yes	Yes

In general, both ROS and IST did not have systems that could fit down a 4-in. riser and still meet the flammable gas controls and/or be radiation tolerant. In Table 4-2, they are ruled out due to not being able to meet the riser size requirement. The existing 'permanent' 12-in. camera cannot fit in a 4-in. riser either.

The existing camera systems were able to meet all requirements.

4.5.3 Evaluation of Remaining Alternatives Versus Goals

The principal method of assessing the remaining systems is a LCCA. The LCCA will assess how well the systems meet reliability, radiation tolerance, and overall cost minimization goals. This cost analysis is contained in Appendix C. The 4-in. permanent camera system has a significant life-cycle cost advantage over the 4-in. MCCS ($73,542 vs. $236,345) when discounted to year 2000 dollars. This is principally because the MCCS camera module will need to be replaced approximately every two days in the design radiation field. This is based on the camera needing to be in the tank ten weeks out of the year.

However, if the camera is needed for a significantly reduced duty cycle for a year, it may be more cost effective to use the MCCS camera. Several additional LCCA were run and it was determined that if the camera system were used for up to three weeks per year in a tank, the MCCS could be used cost effectively. Therefore, the system might be considered for short-term applications such as for viewing construction activities. This analysis is also contained in Appendix C.

Since the LCCA assessed the reliability aspects, possible problems and solutions are also discussed here. The first time the 4-in. permanent camera system was used, the pan and tilt unit failed after only two weeks. A contributing factor to this was that the camera was installed where it impacted on an installed piece of equipment while it was being panned. The operator continued to try and pan in that direction until it was determined that it had impacted a piece of equipment that was not shown of the drawings. An investigation should be made into a more robust pan and tilt mechanism that still meets the requirements of fitting through a 4-in. riser. Reliability of the pan and tilt mechanism has also been a concern of the MCCS system and should be investigated also.

The remaining goals that need to be assessed are lens flushing, zoom capabilities, and resolution.

<u>Lens Flushing</u>

Neither the 4-in. permanent system, nor the 4-in. MCCS offers a lens flushing system. This is less of any issue with the MCCS as it will only remain in the tank for a few days at most. Based on past experience, it will also not be an issue when the tanks are relatively cool (less than 120°F), as little condensate will form at these temperatures. However, mixing of waste may cause a waste aerosol to impair viewing requiring lens and light washing. At higher tank temperatures, the view may be impaired some without a flushing system due to condensate on the lens. The MCCS has a slight advantage here, but it may be possible to add some type of system to the permanent installation. The tradeoff would be increased complexity, which may decrease the already somewhat questionable reliability.

Zoom Capabilities

The MCCS offers a zoom capability of 8:1 while the 4-in. permanent system has a zoom capability of 4:1. For purposes of the W-521 project, which is to view tank equipment for movement a 4:1 zoom capability is more than adequate. If there are additional requirements for zoom capability in the tank at the same time, this should be taken into consideration.

Resolution

Each camera system is capable of resolving 1/32-in. wide line on a medium gray card at a distance of 40 ft. and a 1-in. black square on a medium gray card at a distance of 65 ft. if the lighting is adequate. The 4-in. permanent system uses two 75-watt lamps, while the MCCS uses only one 75-watt lamp. However, it has been stated that with just the 75-watt lamp in use, objects beyond 35-40 ft. away cannot be seen, and two lamps is not a significant improvement. This may not meet the requirement of being able to see all in-tank equipment depending on the equipment installed in the tank. For both systems it is therefore recommended that an additional explosion proof floodlight be used through another 4-in. riser. This should not be difficult, and each of the camera systems has an identical need for this.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The preferred or recommended alternative for applications longer than three weeks per year is the a permanently installed camera system (either 12-in. or 4-in.). For applications shorter than three weeks per year, the 4-in. MCCS is the recommended system. Both of these systems have identified problems that should be addressed by the maintenance organization as necessary. It may be beneficial to prepare a specification for competitive bid where the proposals of two or more companies are assessed against the requirements. Any claimed improvements must be clearly demonstrated by rigorous testing prior to installation in the tanks. However, this may ultimately be a more costly approach than continuing to work with the current vendor to make needed improvements, which should also be demonstrated by rigorous testing.

It should also be noted, that although the 12-in. permanent camera was not evaluated further because it has previously been shown to meet all requirements other than use in all 4-in. riser. This system can be used (and in fact, is the most effective system) where 12-in. risers are available. The 12-in. permanent camera has initial and maintenance costs that are very close to those of the 4-in. permanent camera system, and the system is somewhat more robust. The pan-and-tilt mechanism is more durable, and the lighting system can provide greater illumination to see across the tank. This system would be preferred in any instance where the 4-in. permanent camera is favored over the 4-in. MCCS, and a 12-in. riser is readily available in a location for appropriate in-tank viewing.

6.0 REFERENCES

Campos, B., 2000, *Phone conversation between B. Groth of ARES Corporation and Behta Campos of Remote Ocean Systems*, August 14, 2000, San Diego, California.

CHG 2000a, *Double-Shell Tank Monitor and Control Subsystem Specification*, HNF-4155, Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

CHG 2000b, *Preliminary Test Report 241-AZ-101 Mixer Pump Test,* RPP-6548, Rev 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

CHG 2000c, *Project W-521 Waste Feed Delivery System Conceptual Design Report*, RPP-6333, Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

Jones, G.L., 1999, *Tank Waste Remediation System Technical Safety Requirements,* HNF-SD-WM-TSR-006, Rev. 1, Lockheed Martin Hanford Corporation, Richland, Washington.

NFPA, 1999, *National Electric Code,* NFPA 70, National Fire Protection Association, Quincy, Massachusetts.

Nold, P., 2000, *Numerous phone conversations between B. Groth of ARES Corporation and Pius Nold and Jon Quartly of IST Corporation*, August 14 to August 29, 2000, Morrison, Colorado.

Pedersen, L.T., 1995, *Specification for Procurement of Color Video Imaging System For Waste Tank 241-C-106*, WHC-S-0439, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Shumake, H.F., 1999, *Specification for Purged Camera System*, RPP-5166, Rev. 0, Lockheed Martin Hanford Company, Richland, Washington.

Staehr, T.W., 2000a, *Low-Activity Waste Feed Process Control Strategy*, HNF-5146, Rev. 0, COGEMA Engineering, Richland, Washington.

Staehr, T.W., 2000b, *High-Level Waste Feed Process Control Strategy*, HNF-5145, Rev. 0, COGEMA Engineering, Richland, Washington.

WHC 1996, *CCTV Procurement Specification for Tank 241-C-106*, WHC-S-0439, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Appendix A
Reference Table of Existing Systems and References

IN-TANK VIDEO SYSTEM INFORMATION INDEX

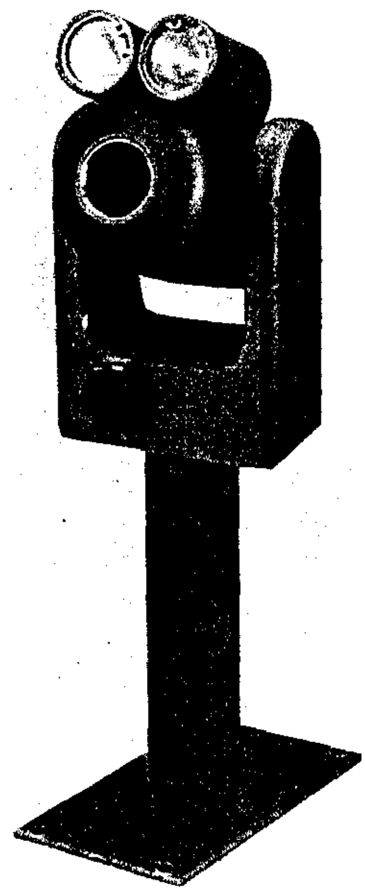
TANK FARMS	TANK/RISER	DESIGN TYPE	VENDOR INFOR FILE	VIDEO SYSTEM DRAWINGS	PURGE SYS DRAWINGS	POWER SOURCE & DRAWING	SUPPORTING DOCUMENTS						REFERENCE DRAWINGS	COMMENTS
							PROCUREMENT SPEC	SYSTEM DESIGN DESCRIPTION	STRESS ANALYSIS	TEST PROCEDURES	SAFETY REVIEW DOCS.	DESIGN/TEST REPORT INFO.		
AN	103/5B	20"	22680	H-2-822810 mech H-2-824647 elect H-14-030601	H-14-100156, 160, 161		PR #122309 WHC-S-0364		WHC-SD-WM-DA-204	OTP/OTR-181	TF-94-0034-TV-FGWL-DST			COLOR CAMERA, 42" MULTIPORT (20" PORT)
	104/5B	20"	22680		H-14-100157, 160, 161		PR #122309 WHC-S-0364		WHC-SD-WM-DA-204	OTP/OTR-182	TF-94-0034-TV-FGWL-DST			COLOR CAMERA, 42" MULTIPORT (20" PORT)
	105/5A	20"	22680		H-14-100158, 160, 161		PR #122309 WHC-S-0364		DA-204	OTP/OTR-183	TF-94-0034-TV-FGWL-DST			COLOR CAMERA, 42" MULTIPORT (20" PORT)
	107/7A	12"	22590	H-2-85573-E			PR #333982	WHC-SD-WM-SDD-051	WHC-SD-WM-DA-178	WHC-SD-WM-OTP-165				COLOR CAMERA, 12" RISER
AW	101/5B	20"	22582	H-2-822801 H-2-821451 H-2-822802	H-2-70324 H-2-818144	ELECT.EDS-DP-201 H-14-030002	PR #359426		WHC-SD-WM-DA-163	WHC-SD-WM-OTP/OTR-159	TF-94-0034-TV-FGWL-DST			COLOR CAMERA, 42" MULTIPORT (20" PORT)
	104	TBD												
SY	101/5A	20"	22580		H-2-822793, 794, 795	EDS-DP-304/H-2-140102	PR #371963	WHC-SD-WM-SDD-054	WHC-SD-WM-DA-164	WHC-SD-WM-OTP-158	TF-94-0034-TV-FGWL-DST	WHC-SD-WM-OTP-158	H-2-821101 (MULTIPORT)	2 COLOR CAMERAS, 42" MULTIPORT (20" PORT)
	101/5B Out of Service		N/A	H-2-822805 H-2-822806	H-2-83072, Superceded by H-14-020631 Sht. 6 & Sht. 8 073, 074	PNLBD B, H-2-37734 (B/W old)		WHC-SD-WM-CR-039		WHC-SD-WM-OTP-116	SAD-005	WHC-SD-WM-OTR-116	H-2-13167 H-2-81819	B/W CAMERA (42" RISER)
	102	20"	22773		H-14-100660 H-14-100662		PR # A24167 WHC-5-0364			WHC-SD-WM-OTP-222		WHC-SD-WM-OTP-222		
	103/5B	42"	22587 22681		H-2-821236, 237, 238	EDS-DP	PR #35904 PR #422285 WHC-5-0364		DA-145 ETS-SW-96-1217	OTP/OTR-161 OTP/OTR-217	TF-94-0034-TV-FGWL-DST		H-14-100609	COLOR CAMERA (42" ADAPTER/20" PORT)
ALL	N/A	3" Portable	22728	See VI File	See VI File	Farm Specific/or Generator Supplied	PR 408176 & 422291	WHC-SD-WM-SDD-078		ATP 173 Functure Check Procedure in	USQ-TF-95-0103 USQ TF-97 0001			FLAM GAS APPROVED SYSTEM PORTABLE CAMERA AND PURGE AIR SYSTEM, 3"
AP	102 FUTURE W211													
	104 FUTURE W211													
AZ	101	4"	22515 Supp. 44	H-14-103849	H-14-020607 (P & ID Drawing)	H-2-78870 (Drawing Index) H-2-68330	PR 408171 WHC-S-0410	N/A		WHC-SD-WM-ATP-181 ATP-260-003 QTP-260-003	USQ-TF-00-0022	WHC-SD-WM-ATR-181		4" COLOR SYSTEM-SHIELDED
	102 FUTURE W211													

Appendix B
Vendor Information on New Alternatives/Upgrades

ist-rees

Visual Imaging Systems

RC2126
Unitized High Resolution Color CCD Camera System with Pan/Tilt/Lights



Features

- Air or underwater operation
- Safe low voltage DC operation
- Purgeable/pressurizable
- Single cable operation
- *High resolution video to resolve ½ mil wire at* 1.8m (6ft) distance
- Field serviceable/replaceable components
- Auto focus and iris control

Applications

- Nuclear fuel inspection
- Reactor vessel inspections
- Tank inspections
- Steam headers
- Surveillance
- Large diameter pipes
- Snubber and hanger inspections
- Weld inspections

RC2126 Specification

Camera & Camera Housing (PAL or NTSC)

Type	1/3" Hyper-HAD CCD
Resolution	>380 H TV lines - 24:1 lens >460 H TV lines - 12:1 lens
Zoom	24:1 (5.4mm-130mm) Optical/digital 12:1 (5.4mm-65mm) Optical
Focus	Auto and manual with macro capability
Iris	Auto f1.8 - close
Sensitivity	7 lux at f1.4
Gain	AGC 0dB - 18dB
Electronic shutter	Auto 1/60 - 1/10,000 sec.
Size (camera head)	74mm x 57mm 139mm (2.89" x 2.25" x 5.46") (h x w x l)
Construction	Clear anodized aluminium and stainless steel Optional full stainless steel 7kg (15 lbs)
Environment	Waterproof to 45m (150 feet)
Temperature	-18C° - 66°C (0°F - 150°F)

Cable

Diameter	8.25mm (0.33")
Length	30m (100 ft) standard (up to 150m (500 ft) available)
Material	Polyurethane jacket with 230kg (510 lb) kevlar strength member

Mechanical

Pan and Tilt

		Pan	Tilt
Range		±175°	+129°/-105°
2 speeds	high	25°/sec	25°/sec
	low	12°/sec	12°/sec
Torque		0.5Nm (75oz in)	0.7Nm (100oz in)
Clutch		Yes	Yes

Size (with camera)	264 mm x 122mm x 152mm (10.4" x 4.8" x 6.0") (h x w x l)
Depth rating	45m (150 feet)
Mounting	Four 1/4" - 20 - UNC mounting points (screws provided outside USA)
Feedback	Optional 10k potentiometer position feedback to monitor
Construction	Clear anodized aluminium and/or Stainless steel
Weight Aluminium	3.4kg (7.5lbs)
Weight Stainless Steel	6.8kg (15lbs)

All internal wiring

Unitized PTZ fits through a 140mm (5.5") diameter hole

Lighting

2 each 35 watt spot or flood with focused dichroic reflectors

35 watt flood: 1500 cp @ 30 degree beam spread

35 watt spot: 3000 cp @ 20 degree beam spread

Camera Control Unit

Height	181mm (7.125")
Width (max)	343mm (13.5")
Depth (max)	368mm (14.5")

Modular design with slide-in cards

Lamp intensity control

2 speed pan and tilt joystick (standard); continuous pan (optional)

Super Video (Y-C) and composite EIA-170A (NTSC video output)

Power .... 110VAC 60Hz or 220VAC 50Hz

Optional Accessories

- CO_2 pressurization kit
- Interconnecting/telescoping 6m (20 ft) pole
- Slip-ring cable drum
- Extended cable lengths up to 183m (600 feet)
- S-VHS VCR
- S-Video monitor
- Purge and pressurize certification for use in hazardous atmospheres

Field of View

12:1 Zoom Module

	Wide Angle	*Telephoto*
Framing Angle (V x H)	38° x 50° x 58°	3.3° x 4.3° x 5.4°
Minimum Focus	Contact	30"

24:1 Zoom Module

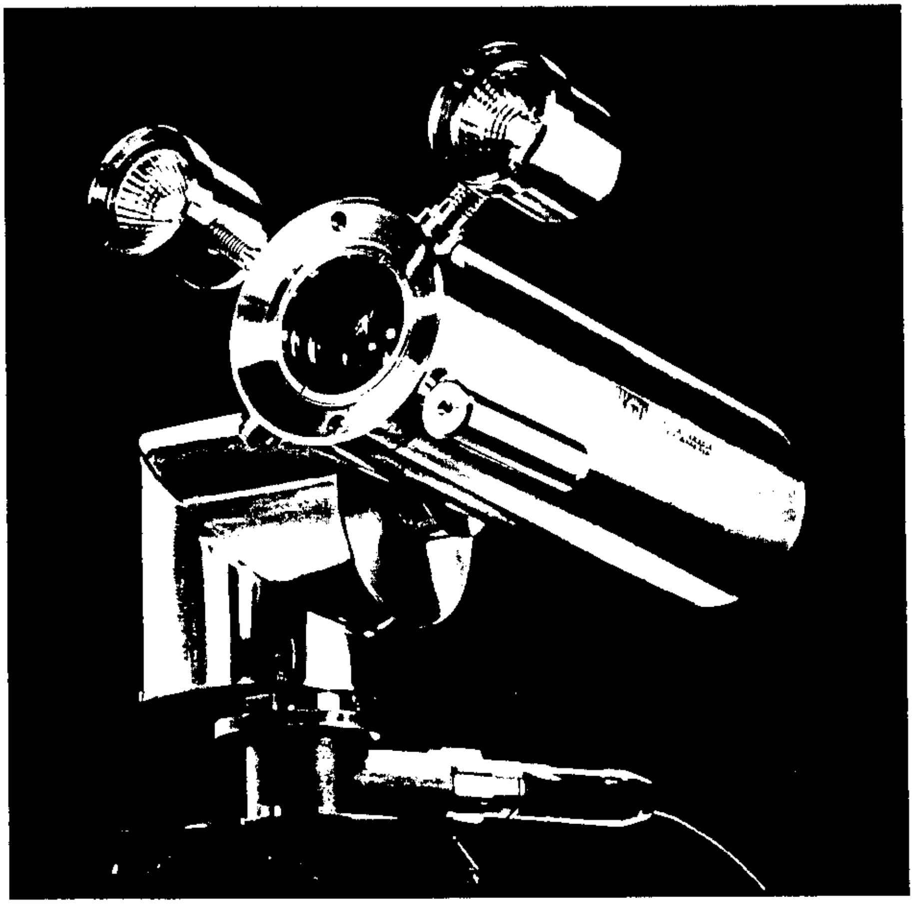
	Wide Angle	*Telephoto*
Framing Angle (V x H)	31° x 42° x 51°	1.4° x 1.8° x 2.3°
Minimum Focus	Contact	30"

RPP-7069, Rev. 0

ist-rees

Visual Imaging Systems

R980
System Camera



Features

- Class leading radiation tolerance
- Pan/tilt zoom operation over just three twisted pairs + screen
- Designed for use in-cell in air or in-reactor underwater
- Just one sub-rack can drive up to 8 cameras
- Just one RS485 interface card can control up to 8 cameras
- Single channel controller available
- Interchangeable camera heads (without adjustment)
- In-built caption generator per camera channel
- Conforms to latest EU Directives
- Designed, manufactured, sold and supported to ISO 9001
- Lower installation costs and simpler site cabling and termination

Plus all the features that you would expect from a modern camera designed for multi-camera system use: genlock, auto/manual iris, picture sharpness enhancement (which reduces with increasing gain to avoid enhancing noise) preset links for different cable lengths (0 -100m, 50 - 150m, 100 to 200m), and preset links for 525/60Hz or 625/50Hz operation. Moreover a number of special features and circuits have been incorporated in the R980 camera to give a more stable performance with time and accumulated radiation dose, including: automatic gain, auto black level and beam current stabilization.

R980 Camera Outstations

The R980 camera outstation comprises a camera mounted on a pan and tilt head with integral wiring. The cable to the outstation connects to the pan and tilt base, so there are no moving cables. The integral wiring produces a neater, more compact and streamlined camera outstation which is far superior, especially for applications involving remote handling. The camera electronics uses the latest surface mount technology to ensure high reliability. Two radiation tolerant lenses are available, the 12-72mm for general use and the 24-144mm when more detail is required. Macro focus is standard on the R980 CMC to enable close focus to within 50mm of the camera, and a preset mechanical stop allows the use of Macro focus without having to subsequently adjust the zoom lens tracking. The R980 CMC has electrical contacts for lighting and audio accessories. The focus range for the other cameras is 1m to infinity.

Alternative cameras provide the following options:

R980 CMA	12-72mm zoom lens, 1m to infinity
R980 CMC	12-72mm zoom lens, macro focus (to 50mm in zoom out), contacts for lighting and audio accessories
R980 CMD	24-144mm zoom lens, 1m to infinity

Alternative pan and tilt heads offer:

R980 PTA	Fischer underwater latching connector
R980 PTB	LEMO remote handling connector (fully washable)

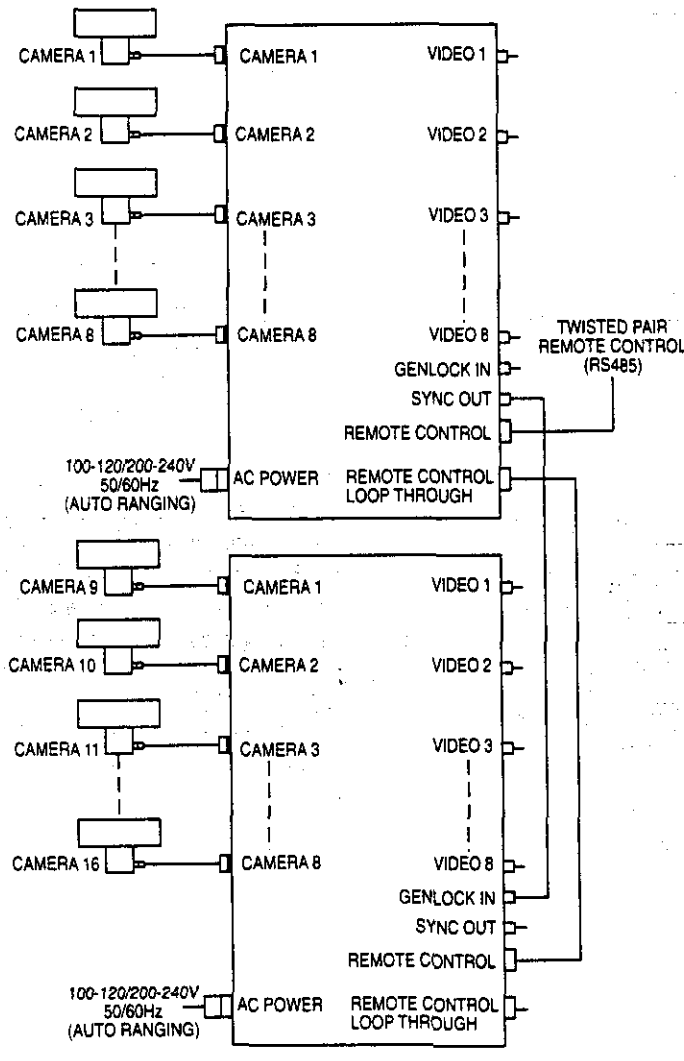
A range of cable assemblies is available for each connector type, see 'Camera Cables & Connectors'.

System Integration

R980 cameras can be easily interfaced to either an application specific television control SCADA, or the complete plant's process control. They use simple cables, just three twisted pairs and a screen for a complete pan/tilt/zoom outstation. Large numbers of cameras can be controlled from one sub-rack, reducing the requirement for main equipment racks and bays. To reduce the number of conductors through an electrical penetration a single pan and tilt supply can be connected to a number of different pan and tilt heads.

The Camera Controller Card type R980CUA08A fits into a sub-rack for 1 to 8 cameras. Each sub-rack, type R980CUA03A is fitted with a common power supply, SPG card, and RS485 Telemetry Interface Card which drive, synchronize and control all functions for 1 to 8 cameras. All of the cameras associated with a particular sub-rack are locked together to reduce the visibility of any cross-talk and to eliminate picture roll when switching between cameras. A number of sub-racks can easily be locked together as each rack has a genlock input. In addition each sub-rack has a serial control input and a loop through connector to enable all cameras in a system to be controlled by a single twisted pair. (IST-Rees's RS485 protocol is available for customers who wish to integrate cameras into an overall plant process control system). The Telemetry Interface Card includes a caption generator for each 1 to 8 camera sub-rack, the captions are stored in an EPROM which can be programmed for each application. Two lines of text can be individually positioned at the top or bottom of the picture and each character can have a black background to improve visibility.

A single channel camera controller is available - please request R980 MCA/B data sheet.



Camera Cables & Connectors

The cable requirement for the System Camera is 1 twisted pair for video/line power, 1 twisted pair for telemetry/timing, 2 cores for pan and tilt power and an overall screen. A number of different cable and connector combinations are available as standard for R980 System Cameras. They are listed in the table below, all of them are radiation tolerant to 1MGy (10^8 rads). All of the connectors concerned are radiation tolerant and constructed from stainless steel.

In the table below "LSF" = Low Smoke, Low Fume; LSF cables are not available for underwater use, as the relative specification requirements are incompatible. The term "length" refers to the maximum separation between a camera and the sub-rack for a particular cable. Cables can be cut and terminated to suit particular applications.

Connector	*Cable*	*Diameter (mm/inches)*	*Length (meters/feet)*	*Installation Bend Radius (mm/inches)*	*Lights*	*Air/Water Application*	*Cable Assembly*
Fischer	3 pair, LSF	6mm/ 0.24"	35m/110'	36mm/1.5"	N/A	Air	R980CAB04A
Fischer	4 pair, LSF	10.4mm/0.41"	200m/650'	75mm/3.0"	N/A	Air	R980CAB06A
Fischer	10 core	9mm/ 0.36"	100m/325'	65mm/2.5"	12V	Underwater/Air	R980CAB08A
Fischer	8 core	9mm/ 0.36"	100m/325'	65mm/2.5"	110V	Underwater/Air	R980CAB10A
LEMO RHC	3 pair, LSF	6mm/ 0.24"	35m/110'	36mm/1.5"	N/A	Air	R980CAB05A
LEMO RHC	4 pair, LSF	10.4mm/0.41"	200m/650'	75mm/3.0"	N/A	Air	R980CAB07A
LEMO RHC	10 core	9mm/ 0.36"	100m/325'	65mm/2.5"	12V	Air	R980CAB09A
LEMO RHC	8 core	9mm/ 0.36"	100m/325'	65mm/2.5"	110V	Air	R980CAB11A

Performance & Specifications

Overall System Performance

Horizontal resolution: .... 600 tvl per picture height

Sensitivity: .... 1 lux (0.09 footcandle) faceplate illuminance (Chalnicon, tungsten lighting 2856K, AGC at 0dB)

Scene illumination: .... 20 lux (1.9 footcandle) (Chalnicon tube, 60% average scene reflectivity, tungsten illumination 2856K, AGC at 0dB, 12 to 72mm NB zoom lens at f/1.8)

200 lux (19 footcandle) (antimony trisulphide vidicon)

AGC range: .... -6dB to 20dB

Signal to noise ratio: .... 43dB (CCIR weighted, AGC at 0dB)

Geometrical Distortion: .... 2% maximum (excluding lens)

Input power operating range: .... 85-132/170-264V (autoranging), 47-440Hz

Power requirement: .... 150VA for a fully populated eight channel sub-rack

Camera cable length: .... 200m (650')maximum camera to controller (4 pair cable, refer to the table for alternative cables)

Camera Outstation Environment

Operating ambient temperature: .... 0°C to 55°C (32°F to 131°F) (Chalnicon tube)
0°C to 40°C (32°F to 104°F) (antimony trisulphide vidicon tube)

Total radiation dose: .... 1MGy (H_2O) [^{60}Co] at 20kGy/hour (10^8 rad at 2×10^6 rad/hour)

Operating dose rate: .... 1kGy/hour (10^5 rad/hour) (Chalnicon tube)

30kGy/hour (3×10^6 rad/hour) (antimony trisulphide vidicon tube)

Sealing: .... IP68 (IEC 529) 60m (200')water depth

(Fischer stainless steel connector)

IP66 (IEC 529) fully washable

(LEMO stainless steel remote handling connector)

Maximum operating depth: .... 20m (66') (with underwater connector)

12-72mm Lens System

Viewing Angles	*In Air: Wide*	*Telefoto*	*In Water: Wide*	*Telefoto*
Horizontal	40°	7.0°	30°	5.3°
Vertical	31°	5.2°	23°	3.9°
Diagonal	49°	8.7°	37°	6.6°

24-144mmLens System

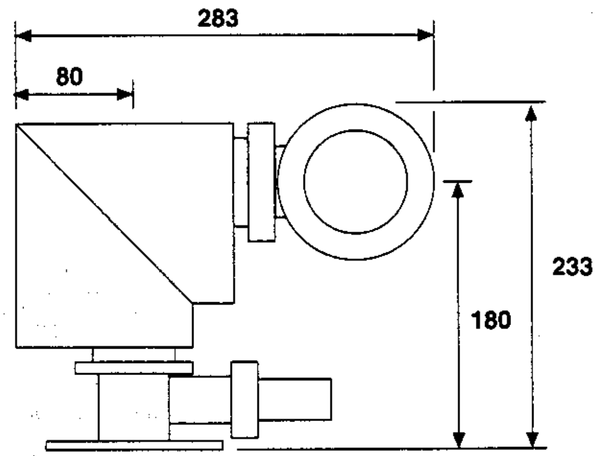
Viewing Angles	*In Air: Wide*	*Telefoto*	*In Water: Wide*	*Telefoto*
Horizontal	21°	3.5°	16°	2.6°
Vertical	16°	2.6°	12°	2.0°
Diagonal	26°	4.4°	19°	3.3°

Controller Sub-rack Environment

Operating ambient temperature: .... 0°C to 40°C (32°F to 104°F) (fully populated, convection cooled)
0°C to 50°C (32°F to 122°F) (up to six channels, convection cooled)

0°C to 50°C (32°F to 122°F) (fully populated, forced air cooling 500 litres/minute)

Relative humidity: 20% to 75% non-condensing



Dimensions

Pan/Tilt/Zoom Camera Outstation

Height: .... 233mm (9.2")

Length: .... 346mm (13.6")

Width: .... 283mm (11.1")

Weight: .... 13kg (29 lb)

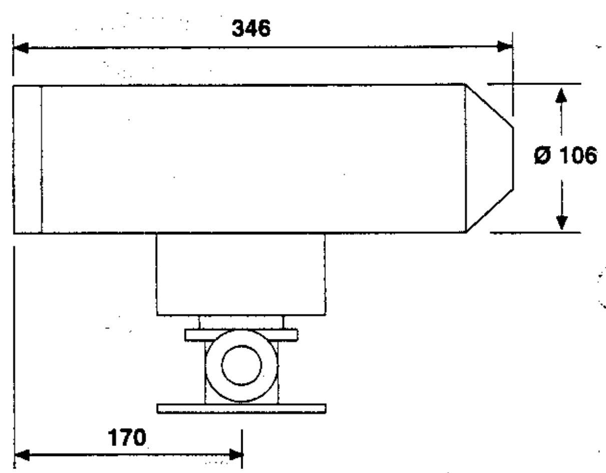
Controller Sub-rack

Height: .... 134mm (5.3")

Width: .... 483mm (19.0")

Depth: .... 300mm (11.8") (excluding handles and connectors)

Weight: .... 6kg (13 lb) approx.



Notes...

1. ***IST-Rees should be consulted with regard to very critical viewing requirements, or in cases where there are important lighting, resolution, environmental or viewing angle considerations.***

2. ***In applications where there are severe space constraints care should be taken to allow for the size of the camera cable mating connector, and if necessary, the bend radius of the connecting camera cable.***

For additional information: **http://www.istcorp.com**

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Imaging & Sensing Technology Corporation

3358 Route 352
Corning, NY 14830 USA
Tel: 607-562-3646
800-432-1478
Fax: 607-562-3804
E-mail: istrees@istcorp.com

Rees Instruments Ltd.
an *IST* company

Station Road
Alton, Hampshire
GU34 2PZ, UK
Tel: 01420 541600
Fax: 01420 541700
E-mail: info@ist-rees.com

Rees Instruments Kommunikationsbü
an *IST* company

Siemenstrasse 8
D 53121 Bonn
Deutschland
Tel: 0228 625088
Fax: 0228 626300

DS1 0499

Appendix C
Life-Cycle Cost Analysis

In conducting the life cycle cost analysis, information must be obtained on the procurement, installation, operating, duty cycle and maintenance costs for the alternatives being compared. For this analysis, the information was then entered into the *NIST "Building Life Cycle Cost" Program* (BLCC4 2000). This program uses appropriate discount rates to compare the total life cycle costs of an alternative and therefore recommend a preferred alternative based on cost.

The procurement costs and maintenance costs for the alternatives were obtained from the Hanford Tank Farms Maintenance and Reliability Engineering group (Shuford 2000) and are summarized below.

Alternative	Video System Procurement Costs	Purge and Purge Control Procurement Costs	Total Procurement Costs	Maintenance Costs (annual)
4-inch Permanent System	$127K	$25K	$152K	$25K
4-inch MCCS	$34K	$8K	$42K	Not provided

The exception is that the annual maintenance costs for the 4-inch MCCS were not provided in this memo, but were calculated based on the radiation tolerance of the camera and the cost of replacement which will be determined following the determination of installation costs.

The installation costs were determined based on estimates prepared during the W-521 Conceptual Design Report and interviews with operators familiar with installation of both types of camera systems.

Installation Cost Details

Description	Rate	Hours	Total
Installation of Permanent Camera Infrastructure			
Electrician	$44	68	$2,992
Pipe Fitter	$46	68	$3,128
Labor	$32	68	$2,176
Operator	$36	32	$1,152
Teamster	$36	16	$576
Crane 40 Ton Hydraulic	$67	24	$1,608
Flat Bed Truck	$35	24	$840
Total			**$12,472**
Installation of Permanent Camera			
Electrician	$44	32	$1,408
Pipe Fitter	$46	32	$1,472
Labor	$32	32	$1,024
Operator	$36	18	$648
Teamster	$36	20	$720
Crane 40 Ton Hydraulic	$67	16	$1,072

Description	Rate	Hours	Total
Flat Bed Truck	$35	16	$560
Total			**$6,904**
Removal of Permanent Camera			
Carpenter	$32	36	$1,152
Electrician	$44	32	$1,408
Pipe Fitter	$46	120	$5,520
Labor	$32	68	$2,176
Operator	$36	32	$1,152
Teamster	$36	16	$576
Crane 40 Ton Hydraulic	$67	16	$1,072
Flat Bed Truck	$35	40	$1,400
Total			**$14,456**
Installation of Temporary Camera			
Electrician	$44	8	$352
Pipe Fitter	$46	8	$368
Labor	$32	8	$256
Operator	$36	8	$288
Teamster	$36	8	$288
Flat Bed Truck	$35	8	$280
Total			**$1,832**
Removal of Permanent Camera			
Electrician	$44	8	$352
Pipe Fitter	$46	8	$368
Labor	$32	8	$256
Operator	$36	8	$288
Teamster	$36	8	$288
Flat Bed Truck	$35	8	$280
Total			**$1,832**

The annual maintenance costs for the MCCS were then computed based on the following:

The MCCS camera has a radiation life of 10,000 rad. Therefore, in the design radiation field of 200 r/hr, the camera would have a life of approximately 50 hours. For the purposes of this study, this will be approximated that a total of three cameras will be needed per week. Since ten transfers will be performed per year, with a minimum of one week of camera time needed per transfer, a total of 30 replacement cameras will be needed. These cameras have a procurement cost of $5,200 (Werry 2000). The camera is replaced by a simple quick disconnect. However, the costs associated with removing and reinstalling the camera are also associated with this. Therefore the annual maintenance costs would be:

($5,200 + $1,832 + $1,832) * 30 = $265,920

This is clearly a very significant cost associated with these cameras.

These costs were then entered into the BLCC4 life cycle cost analysis software. In input file and the results file are shown below.

Input File

```
QBLCC filename =  CCTV.QI
Analysis type = Federal Analysis--Projects Subject to OMB A-94
Project name = W-521 CCTV
Base Date of Study = 2000
Service Date        = 2004
Study Period = 5 years
Discount rate =  4.0%
Inflation rate =  0.00%
Cap replacements and residual values (if any) included as investment costs.
Residual values automatically calculated for capital components.
Residual values automatically calculated for capital replacements.


Number of alternatives in file = 2
Number of groups in file = 1

                                                    CAPITAL       ANNUAL  NON-ANNUAL OM&R
 ALT ALTERNATIVE  GROUP  LIFE  INITIAL     REPLACEMENTS    OM&R   ---------------
  #     NAME      CODE  (Y/M)  COST($)    FREQ*  COST($) COST($) FREQ*    COST($)
 --- ------------ ----  ----- ---------  ----- -------- ------- -----   --------
  1  Permanent          3/0      171376  0/0            0   25000 0/0            0
  2  MCCS               3/0       43832  0/0            0  265920 0/0            0

  *FREQ = Frequency of occurrence (in years/months)
```

Output File

```
QuickBLCC (QBLCC 2.7-00)    08-29-2000/11:04:08

QBLCC filename =  CCTV.QI
Analysis type = Federal Analysis--Projects Subject to OMB A-94
Project name = W-521 CCTV
Base date of study = 2000
Service date =        2004
Study Period = 5 years
Service Period = 1 years
Discount rate =  4.0%
Annually recurring costs and energy costs discounted from middle of year.

Number of alternatives in file = 2
Number of groups in file = 1

Note: Project alternatives displayed in increasing order of investment cost

 Group code:      -----------------Present-Value Costs----------------
```

Alternative Name	Investment Costs*	OM&R Costs	Energy Costs	Total Life-Cycle Costs
MCCS	$13450	$222895	$0	$236345
Permanent	$52587	$20955	$0	$73542<--MIN LCC

```
Comparative measures are only calculated for the alternative with lowest
LCC relative to alternative with the lowest present-value investment cost.

Comparative economic measures for Permanent relative to MCCS:
NET SAVINGS =      $162803;  SIR =  5.16;  AIRR = 44.40%
Ratio of present-value energy savings to total savings =  0.00

* Investment costs include capital replacements and residual values (if any).
  Residual values for initial capital investment are calculated when life
  extends beyond end of study period.
  Residual values for capital replacements are calculated when life extends
  beyond end of study period.
```

From the life cycle cost analysis it can clearly be seen that the 4-inch permanent camera system has a significant life cycle cost advantage. However, if the camera is needed for a significantly reduced duty cycle for a year, it may be more cost effective to use the MCCS camera. Several additional life cycle cost analyses were run and it was determined that if the camera system were used for up to three weeks per year in a tank, the MCCS could be used cost effectively. Therefore, the system might be considered for short term applications such as for viewing construction activities. The BLCC4 output file for using the camera for 3 weeks is shown below.

Output File (3 weeks per year)

```
QuickBLCC (QBLCC 2.7-00)    08-29-2000/14:20:33

QBLCC filename =  CCTV3W.QI
Analysis type = Federal Analysis--Projects Subject to OMB A-94
Project name = W-521 CCTV
Base date of study = 2000
Service date =       2004
Study Period = 5 years
Service Period = 1 years
Discount rate =  4.0%
Annually recurring costs and energy costs discounted from middle of year.

Number of alternatives in file = 2
Number of groups in file = 1

Note: Project alternatives displayed in increasing order of investment cost
```

Group code: Alternative Name	Present-Value Costs: Investment Costs*	OM&R Costs	Energy Costs	Total Life-Cycle Costs
MCCS	$13450	$66869	$0	$80319
Permanent	$52587	$20955	$0	$73542<--MIN LCC

Comparative measures are only calculated for the alternative with lowest LCC relative to alternative with the lowest present-value investment cost.

Comparative economic measures for Permanent relative to MCCS:
NET SAVINGS = $6776; SIR = 1.17; AIRR = 7.38%
Ratio of present-value energy savings to total savings = 0.00

* Investment costs include capital replacements and residual values (if any). Residual values for initial capital investment are calculated when life extends beyond end of study period. Residual values for capital replacements are calculated when life extends beyond end of study period.

References

BLCC4, 2000, *The NIST "Building Life Cycle Cost" Program,*, version 4.3, National Institute of Standards and Technology, Washington, D.C.

Shuford, D.H., 2000, *RPP In-Tank Video System Overview and Cost Summary – Project W521 Conceptual Data Inquiry*, Interoffice Memo 74600-00-034 to G.W. McLellan, August 23, 2000, CH2M Hill Hanford Group, Richland, Washington.

Werry, S.M., 2000, per phone conversation with B.D. Groth, of ARES Corporation, August 29, 2000.

Attachment K

Attachment K

Evaluate Performance of Instrumentation

EVALUATE PERFORMANCE OF INSTRUMENTATION

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD, INC.
Contract 4412, Release 46
Report No. 990920203-005
ADCR Subtask 11
Revision 0

September 2000

prepared by

HND TEAM

EVALUATE PERFORMANCE OF INSTRUMENTATION

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD, INC.
Contract 4412, Release 46
Report No. 990920203-005
ADCR Subtask 11
Revision 0

September 2000

Prepared by: Michael Garcia, P.E.

Approved by: RL Fritz
Robert L. Fritz

Date: 9-30-00

Table of Contents

Appendices

Acronyms

CCTV	Closed Circuit Television
DST	Double-Shell Tank
ECR	Effective Cleaning Radius
HMI	Human-Machine Interface
LANL	Los Alamos National Laboratory
OTP	Operational Test Procedure
PNL	Pacific Northwest Laboratories
RCS	Retrieval Control System
RTD	Resistance Temperature Device
SHMS	Standard Hydrogen Monitoring System
SSP	Suspended Solids Profiler
TFLAN	Tank Farm Local Area Network
TMACS	Tank Monitoring and Control System
URSILLA	Ultrasonic Interface Level Analyzer
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

Project W-521, "Waste Feed Delivery Systems," will upgrade systems, structures, and components at eight double-shell tanks (DST) as necessary to assure successful and reliable Phase 1 waste feed delivery to the Waste Treatment Facility. The eight DSTs included in Project W-521 are AW-101, AW-103, AW-104, AY-101, AY-102, SY-101, SY-102 and SY-103. Although the scope of this document addresses Project W-521 DSTs, there is a direct application to other tanks and projects.

During the conceptual design phase of the project, various questions and concerns were raised about the capabilities and requirements of the instrumentation system. Also, since preparation of the CDR, numerous changes have been made to the requirements contained in the Level 2 specification, HNF-4155, Rev 1, (DRAFT) *Double-Shell Tank Monitor and Control Specification*. In order to address all of these items, several tasks were undertaken as part of the Advanced Conceptual Design (ACD) effort. This subtasks evaluates potential improvements to the W-521 instrumentation and recommends how best to incorporate the latest Data/Requirements.

1.1 Purpose

This evaluation reviews key tank farm operational experiences and lessons learned and compares these findings to the W-521 Conceptual Design. Recommendations for modification to the W-521 Retrieval Control System (RCS) design are presented. This report also identifies any issues that require further resolution.

1.2 Scope

The recent tank farm operations that are used primarily as input to this report are:

- W-320, Tank 241-C-106 Sluicing, and
- W-151, 241-AZ-101 Mixer Pump Test.

Also, other pertinent documents and discussions are utilized as referenced.

2.0 METHODOLOGY

Section 4.0, the discussion section of this paper, is organized by process parameter, (i.e. level, density, solids profile, etc). For each process parameter, the following discussion points are addressed.

First, the applicable section of the Double-Shell Tank (DST) Monitor and Control Subsystem Specification, HNF-4155, are identified at the beginning of each section. Applicable sections from HNF-4155 the DST Monitor and Control Subsystem Specification are included in Appendix A.

Next, the key operational experiences and lessons learned from previous waste tank operations related to the W-521 RCS are summarized, and design improvements are recommended for incorporation into the W-521 RCS design.

Finally, any issues that require further analysis are identified.

Primarily, the data and/or information used in this evaluation was obtained from the following references:

- RPP-5687, Rev. 0, 3-2-00, "Waste Retrieval Sluicing System and Project W-320, Tank 241-C-106 Sluicing, Lessons Learned", CH2M HILL Hanford Group, Richland, Washington.
- HNF-4379, Rev. 1, 6-29-99, "Waste Retrieval Sluicing System Campaign Number 1 - Solids Volume Transferred Calculation", LMHC, Richland, Washington.
- RPP-6548, Rev. 0, 7-17-00, "Preliminary Test Report 241-AZ-101 Mixer Pump Test", CH2M HILL Hanford Group, Richland, Washington.
- "WASTE TANK SLURRY TECHNOLOGY DEVELOPMENT AND TESTING OVERVIEW" dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.
- HNF-4155, Rev. 1, (DRAFT) 4-27-00, DST Monitor & Control Subsystem Specification, CH2M HILL Hanford Group, Richland, Washington.
- HNF-5145, Rev. 0, 6-14-00, "High-Level Waste Feed Process Control Strategy", CH2M HILL Hanford Group, Richland, Washington.
- HNF-5146, Rev. 0, 6-14-00, "Low-Activity Waste Feed Process Control Strategy", CH2M HILL Hanford Group, Richland, Washington.

3.0 ASSUMPTIONS

The existing DST Monitor Control Subsystem Specification is currently being revised. It is assumed that the specification will only be refined, and that it will remain substantially as written.

4.0 DISCUSSION

4.1 Temperature Monitoring

The DST temperatures are monitored to ensure that operating limits are not exceeded. The temperature data will also provide important data during waste tank operations. The DST temperature monitoring capabilities will be made up of existing and new temperature instrumentation. The existing DST structure temperature thermocouples will be utilized as required. New temperature probes will be installed to monitor waste temperatures.

4.1.1 Temperature Monitoring Requirements

Key requirements for temperature monitoring are the monitoring of DST temperatures which includes measuring, transmitting, receiving, recording, trending, and displaying of waste temperatures and DST structure temperatures.

Anticipated new requirements that will come out of the next revision of HNF 4155 are that all insulating concrete temperatures measurements shall be monitored.

The requirements for temperature measurements are documented in HNF 4155, Sections: 3.2.1.1, and 3.2.1.2, and are included in Appendix A of this document.

4.1.2 Summary of RPP-6548, Rev. 0, 7-17-00, "Preliminary Test Report 241-AZ-101 Mixer Pump Test," CH2M HILL Hanford Group, Richland, Washington.

Thermocouples within the sludge layer and in the insulating concrete located below the tank bottom were used during the test to monitor the progression of effective cleaning radius (ECR).

At the end of the mixer pump test, all thermocouples previously covered by sludge, which included air lift circulator thermocouples, sludge thermocouples, bottom profile thermocouples, and tank bottom thermocouples, indicated that sludge had been effectively mobilized.

The tank bottom insulating concrete thermocouples were surprisingly very responsive to sludge mobilization. Tank bottom insulating concrete thermocouples should be utilized in future tank mixing operations. Reference Appendix B, "Mixer Pump 1 (Riser 1C) Fixed Position ECR Testing Results" table, and Mixer Pump(s) Oscillating ECR Testing Results table.

During the mixer pump test nearly all of the "hockey puck" style thermocouples failed due to corrosion of the iron thermocouple extension wire, which is applicable to type 'J' thermocouples.

4.1.3 Recommendations

Project W-521 plans to install one Resistance Temperature Device (RTD) tree in each tank within the scope of the project with exception to the aging waste tanks (241-AY-101 and 241-AY-102) which receive 5 new RTD trees in each tank. Standard industrial RTDs and receiving devices (multiplexer) are available that will exceed the requirements for temperature measurement stated in HNF-4155.

Project W-521 recommends that the tank bottom insulating concrete thermocouples be connected to the RCS. The RCS will send data over the Tank Farm Local Area Network (TFLAN), which would make the data available to the Tank Monitoring and Control System (TMACS) and other Human Machine

Interfaces (HMI) on the TFLAN. This is currently not within the scope of W-521, and some slight additional costs will result.

The majority of tank bottom insulating concrete thermocouples provide local indication at the respective 271 instrumentation buildings, although, some of the insulating concrete thermocouples are currently monitored by TMACS. Reference W-521 paper "Interface With Existing Instrumentation" for a list of process parameters currently monitored by TMACS.

4.2 Suspended Solids Monitoring

During the conceptual design phase of Project W-521, a placeholder was reserved for an instrument capable of measuring one or a combination of in-tank waste properties. The concept is that the measurement of in-tank waste properties would facilitate the waste feed delivery process resulting in a reduction in operating cost.

There are three in-tank solids instruments that were tested during the AZ-101 Mixer Pump Test. All instruments provided a qualitative interpretation of solids mobilization. Graphs produced from measurements from the three instruments are included in Appendix C. The three instruments are:

- Mt. Fury Suspended Solids Profiler (SSP),
- Ultrasonic Interface Level Analyzer (URSILLA), and
- Gamma Monitoring System.

4.2.1 Suspended Solids Monitoring Requirements

There are currently not any requirements for suspended solids monitoring. HNF-4155 does not contain a section that necessitates or recommends monitoring in-tank waste properties such as suspended solids, blending, or sludge mobilization.

Anticipated requirements will most likely include: The DST Monitor and Control Subsystem should have the capability to qualitatively monitor suspended solid data to facilitate waste feed deliver operations.

The Low-Activity Waste Feed and High-Level Waste Feed Process Control Strategies (HNF-5145 and HNF-5146) recommend that instrumentation used to measure sludge mobilization, blending, and suspension of parameters (including the suspended solids profiler, gamma profiler, and ultrasonic interface level detector) be considered for future use based on the results of the AZ-101 mixer pump test.

4.2.2 Summary of RPP-6548, Rev. 0, "Preliminary Test Report 241-AZ-101 Mixer Pump Test," dated July 17, 2000 by CH2M HILL Hanford Group, Richland, Washington.

Qualitative interpretation of measurements from the SSP, URSILLA, and gamma monitoring system data was insightful. Interpretation of the data at a quantitative level will still rely on laboratory analysis of grab samples collected during the test.

4.2.3 Suspended Solid Monitoring Instrumentation

4.2.3.1. Gamma Monitoring System

4.2.3.1.1 Summary of "Waste Tank Slurry technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

The gamma detector is inserted into a 6" riser dry well and lowered to the desired depth. The instrument is comprised of a custom designed cart equipped with a winch system and signal conditioning circuits. A real time data link is provided to the tank farm monitoring and control operator station.

Prior to the mixer pump test, the system was tested at AZ-101 and was found to be successful at detecting the sludge/supernatant interface.

4.2.3.1.2 Summary of RPP-6548, Rev. 0, "Preliminary Test Report 241-AZ-101 Mixer Pump Test," dated July 17, 2000 by CH2M HILL Hanford Group, Richland, Washington.

The output data plots from the mixer pump test are taken from Liquid Observation Wells at depths ranging from 30 to 60 feet below the riser flange. Each reading takes 2-3 minutes. Readings of 150 counts/second appeared to indicate that the probe was positioned in supernatant. Readings between 150 and 250 counts/second appeared to indicate a mixture of sludge and supernatant. Readings above 250 counts/second appeared to indicate sludge.

While the mixer pumps were shut down, operational testing of the gamma monitoring system was successful, and the quality of the data at the conclusion of testing was very good. The Gamma Monitoring System plotted qualitative data that indicated the waste at a specific level to be supernatant, supernatant-sludge mixture, or sludge depending on the signal. An attempt at operating the Gamma Monitoring System during mixer pump operation was not successful.

4.2.3.2. Ultrasonic Interface Level Analyzers

4.2.3.2.1 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

The Royce Model 2511 URSILLA is designed to qualitatively measure solid particulate suspended in supernatant as well as the supernatant/sludge interface.

4.2.3.2.2 Summary of RPP-6548, Rev. 0, "Preliminary Test Report 241-AZ-101 Mixer Pump Test," dated July 17, 2000 by CH2M HILL Hanford Group, Richland, Washington.

The sensor was located approximately 15 feet off the tank bottom. URSILLA probes were installed in risers 5B, 13A, and 16C. The URSILLA installed in riser 16C continued to provide anomalous interface readings, however, a solid material was noticed on an adjacent riser which possibly could have contributed to anomalous readings. Also, the URSILLA probes do not provide useful data when mixer pumps or air circulators are being operated.

Overall, the URSILLA probes performed very well and provided useful, real time data. Reference Appendix B of this document, "URSILLA Profiles from Riser 5B During Settling Testing (1-14 Hours After Pump Shutdown)".

One verbal comment, per phone conversation with Allen Carson who participated in the testing of the URSILLA system, was that this is a very valuable piece of equipment which can be used to provide immediate data.

4.2.3.3. Suspended Solids Profiler (Mt. Fury Profiler - SSP)

4.2.3.3.1 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

This instrument is waste intrusive, and cannot be used in Class 1, Division 1, Group B atmospheres or Group 1 tanks. The profiler may be used in Class 1, Division 2, Group B atmospheres (Hanford Group 2 tanks) if the tank head space is monitored for hydrogen and power is shut off to the profiler control system when the hydrogen reaches 25 percent of the lower flammable limit (LFL).

4.2.3.3.2 Summary of RPP-6548, Rev. 0, "Preliminary Test Report 241-AZ-101 Mixer Pump Test," dated July 17, 2000 by CH2M HILL Hanford Group, Richland, Washington.

The SSP is a commercially available instrument that measures turbidity versus depth in units of parts per million. The probe is drawn into a glove box when not in use. The SSP is equipped with a stepper motor, cable reel, high-pressure spray nozzles, and has the capability to interface with the TMACS via a data link.

Baseline data obtained prior to starting the Operational Test Procedure (OTP) appeared reasonable. Profile data obtained with the first probe during the test appeared erratic, prompting replacement of the probe. Data obtained from the new probe appeared reasonable. As with any turbidity monitor, the values displayed are only relative values. To obtain a more accurate measurement of the suspended solids concentration, it will be necessary to compare the SSP readings to the results from the laboratory analysis of the grab samples.

The SSP caused difficulty during operation due to mechanical malfunction. The cable on the cable reel became entangled, not allowing the probe to be raised or lowered. After replacement of the probe and cable there were no further problems operating the SSP. Later, external radioactive contamination was found on the SSP. The contamination was highest on various flange connections below the SSP housing.

4.2.4 Recommendation for Suspended Solids Monitoring

There is not a requirement for suspended solids monitoring. However, input from individuals directly involved with the AZ-101 Mixer Pump test have indicated that the qualitative data is very important in determining tank mixing.

Ideally, the instrument would be available to quantitatively measure % wt solids and solids profiles. However, the in-tank properties measurement devices that have been tested up to this point only give qualitative feedback for solids profiles. For example, feedback would indicate that the waste within the tank at a given depth is supernatant, a mixture of supernatant and sludge, or mainly sludge.

At this point, since no instruments have been identified to provide adequate quantitative measurements, Project W-521 will continue to identify a placeholder for an instrument that is capable of qualitatively measuring suspension of solids and sludge/supernatant interface. For cost purposes the URSILLA will be utilized.

4.3 In-Tank Density Measurement

Density of in-tank waste could provide a density profile of tank waste during the mixing activities. If a constant density profile was measured along with other measurements such as temperature profiles, one could assume that a given tank waste was sufficiently mixed.

4.3.1 In-Tank Density Measurement Requirements

There are not any key requirements for in-tank density measurements.

At this time there are not any anticipated requirements, however, if a reliable low cost instrument or technique was available, the data would provide valuable insight into the waste feed delivery process.

Attempts to measure in-tank density have also proved to be unsuccessful using the ENRAF level gauge. Possible causes of unsuccessful measurements are discussed later in this document.

4.3.2 Density Instrumentation

4.3.2.1. Ball Rheometer (In-Tank Density and Viscosity)

4.3.2.1.1 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

This device is a prototype developed by Pacific Northwest Laboratories (PNL), Los Alamos National Laboratory (LANL), and Westinghouse Hanford Company (WHC) in 1993-94 to support analysis work in SY-101. It subsequently has been utilized in Hanford tanks SY-103, AW-101, AN-103, AN-104, and AN-105.

The displacer of this instrument accesses the tank through a 4" riser. The ball is lowered to the bottom of the tank and then raised at a constant velocity. The measured force on the cable is used to calculate apparent viscosity. At any given level, density is calculated using the measured force on the cable.

This instrument is comprised of a spray ring spool piece, reel drum and motor actuators, control console, power skid, and ventilation module. All components are packaged as separate units to provide mobility and radioactive contamination control. The control console can be located up to 250 feet from the viscometer to allow personnel to operate the device from outside the tank farm.

The system is reported to have performed flawlessly while in use at the six waste tanks. It is currently stored at Hanford and deployable as required although not easily mobilized into place.

4.3.2.2. ENRAF Densitometer

4.3.2.2.1 Summary of RPP-5687, Rev. 0 "Waste Retrieval Sluicing System and Project W-320, Tank 241-C-106 Sluicing, Lessons Learned," dated May 2, 2000 by CH2M HILL Hanford Group, Richland, Washington.

While the sediment level data from the ENRAF Densitometer was adequate for use, the density data profile was inexplicably erroneous. Control of the densitometer should also be remote. A portable computer requiring two operators had to be set up inside a radiation area in order to control the equipment. Adding a densitometer communications port in the instrument design would be advisable.

4.3.2.2.2 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

The ENRAF has not provided good density measurements to date. The manufacturer makes many different devices that might be more suitable to the tank requirements. Further evaluation is required before the ENRAF is used for density profiling.

4.3.2.2.3 Summary of HNF-4379, Rev. 1, "Waste Retrieval Sluicing System Campaign Number 1 - Solids Volume Transferred Calculation," dated June 29, 1999 by LMHC, Richland, Washington.

The data from the ENRAF densitometer profiles was evaluated and is not providing meaningful data. This density profile data source is therefore considered inconclusive. This anomalous data is believed to be the result of the densitometer plummet support wire dragging on the inside surface of the 4" riser during part of the plummet travel. This is suspected to occur because the 4" riser is not plumb. Additional evaluation of the ENRAF densitometer is needed to correct the postulated wire-dragging problem if possible to make the density profile data useful. Mathematical evaluations simulating the correction of the wire dragging appeared to indicate that the data received correlated fairly well with other process control information.

4.3.2.3. In-Line Density Measurement

There is a requirement in HNF-4155, DST Monitor and Control Subsystem Specification, to measure density at the transfer pump discharge. Section 4.7 of this document.

Project W-521 is currently planning on installing a variable depth pump suction in all tanks with the exception of AW-103 which will get a full-length pump.

One possibility that will require further analysis would involve measuring bulk density of in-tank contents at variable pump suction levels.

At any time during the mixing operation the process could be operated in the recirculation mode, and the in-line density could be recorded respective to the pump suction position. Further analysis is required to determine if this would add any valuable process parameters to the waste feed delivery operation.

4.3.3 Recommendation for in-tank density measurement

Further analysis is required to determine if in-line density measurement from various pump suction levels during the waste feed delivery process would provide useful data.

4.4 Mixer Pump Instrumentation

Primarily mixer pump parameters will be monitored to ensure the proper operation of the mixer pump.

4.4.1 Requirements for Mixer Pump Instrumentation

The key requirements for mixer pump operation include the monitor and control of: motor speed and amps, motor bearing temperature, motor stator winding temperature, turntable rotation and orientation pump vibration, and nozzle discharge pressure.

At this time, no additional requirements that are anticipated.

The requirements for Mixer Pump Instrumentation are stated in HNF-4155 and are summarized in appendix A of this document.

4.4.2 Summary of RPP-6548, Rev. 0, "Preliminary Test Report 241-AZ-101 Mixer Pump Test," dated July 17, 2000 by CH2M HILL Hanford Group, Richland, Washington.

The only significant issue noted relative to the mixer pump instrumentation was that the indicated pump position was 10-15 degrees different than the actual discharge flow direction as determined by strain gauges, temperature readings, and CCTV viewing. This proved to be troublesome when attempting to reposition the nozzle during operation.

4.4.3 Recommendation for Mixer Pump Instrumentation

The indication of direction of pump discharge should be biased at the display to indicate actual mixer pump discharge flow direction or the position feedback should be calibrated to indicate discharge flow direction.

4.5 Level Measurement

Level measurement has been successfully implemented at Hanford for many years. Changes to the current configuration are not anticipated. The ENRAF level gauge will not be operated while the mixer pump is operated.

4.5.1 Requirements for Level Measurement

The key requirement for level measurement includes the monitoring of level. Measurement accuracy is +/- ¼".

At this time, no additional requirements that are anticipated.

The requirements for Level Measurement are stated HNF-4155, Section 3.2.1.13. A summary of these requirements is located in Appendix A of this document.

4.5.2 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

The ENRAF Series 854 level gauge utilized at Hanford in the tanks is adequate. Level measurement is a crucial piece of data that is required to be taken frequently during waste feed delivery operations.

4.5.3 Recommendation for Level Measurement

The existing ENRAF Series 854 level gauge will be utilized for level data. Level data will be received by the W-521 RCS via a TFLAN-TMACS interface. The ENRAF level gauge meets the design requirements stated in HNF-4155.

4.6 Volumetric Flow Measurement

Volumetric flow measurement has been successfully implemented at Hanford.

4.6.1 Requirements for Volumetric Flow Measurement

Key requirements for volumetric flow measurement include monitoring flow at the discharge of the transfer pump. Accuracy of flow measurement shall meet +/- 5%.

At this time, there are not any additional requirements that are anticipated.

The requirements for volumetric flow measurement are stated in HNF-4155. A summary of these requirements is located in Appendix A of this document.

4.6.2 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford.

Volumetric Flow measurement using magnetic flow meters has had good success at Hanford for years.

4.6.3 Recommendation for Volumetric Flow Measurement

The only additional recommendation is to specify embedded electrodes to eliminate exposure of electrodes to the waste. Otherwise, there are no changes anticipated for the method or technology to measure volumetric flow. Standard industrial magnetic flow meters and receiving devices (PLCs) exceed the requirements for volumetric flow measurement requirements stated in HNF-4155.

4.7 In-Line Mass Flow, Density, and Temperature Meter

Mass flow measurement has been successfully implemented at Hanford with exception to the problems associated with entrained gas in the process stream.

4.7.1 Requirements for Mass Flow Measurement

Key requirements for mass flow, density, and temperature is:

- Mass flow accuracy must meet +/- 5%
- Density accuracy must meet +/- 5%
- Temperature accuracy must meet +/- 5 degrees F.

At this time, no additional requirements that are anticipated.

The requirements for mass flow, density, and temperature measurement at the transfer pump discharge are stated HNF-4155, Section 3.2.1.13. A summary of these requirements is located in Appendix A of this document.

4.7.2 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford.

Coriolis mass flow meters have been extensively tested at various DOE facilities for sensing the bulk flow of slurries in pipelines and are highly recommended for flow rate and density measurements. The meter measures bulk density only. The present mass flow meter used at Hanford is the Micromotion ELITE CMF 300, and the accuracy of the meter is expected to be within 5 percent, if it is calibrated with water or a known slurry. The coriolis type meters are not able to perform properly if gas bubbles are present in the waste stream.

The Endress + Hauser coriolis meter is more compact than the Micromotion meter, and would require less installation space.

4.7.3 Summary of HNF-4379, "Conclusions to Waste Retrieval Sluicing System Campaign Number 1 - Solids Volume Transferred Calculation" dated June 29, 1999.

The mass flow meter calculates the percent solids being transferred in the slurry line and integrates this value over time to determine the mass of the solids transferred. The key inputs are the density of the carrier fluid (solids free) and the density of the solids.

The primary method used to calculate the amount of solids transferred is based on the mass flow meter data with appropriate adjustments made for liquid density changes due to dissolution of solids. The mass flow meter solids transfer volume values are calculated using a solids free liquid specific gravity which must be estimated in advance. It is appropriate to check this value after each sluicing operation. If it is determined that the input values diverge significantly from analytical and densitometer data, it is appropriate to make adjustments to the mass flow meter solids transfer values.

4.7.4 Recommendations for Mass Flow, Density, and Temperature Measurement

Coriolis mass flow meters are not capable of measuring mass or density if there are entrained gas bubbles in the waste stream. Project W-521 will attempt to specify a pump that does not use nitrogen charged pump seals.

If space becomes an issue in the pit, then the Endress and Hauser mass flow meter should be considered because of its smaller size. Standard industrial coriolis flow meters meet the requirements stated in HNF-4155.

4.8 Transfer Pump Discharge Pressure Measurement

Discharge pressure measurement has been successfully implemented at Hanford.

4.8.1 Requirements for Transfer Pump Discharge Pressure Measurement

Key requirements include monitoring of transfer pump discharge pressure. Accuracy shall meet +/- 5% of process range.

At this time, no additional requirements that are anticipated.

The requirements for transfer pump discharge pressure measurement are stated in HNF-4155, Section 3.2.1.14. A summary of these requirements is located in Appendix A of this document.

4.8.2 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

The Red Valve Series 48 is the most widely used pressure sensor for measuring waste transfer line pressure at DOE sites. Its accuracy is +/- 1 percent of full scale. A capillary filled system is used so that the slurry is isolated from the pressure transmitter sensor.

4.8.3 Recommendations for Transfer Pump Discharge Pressure Measurement

The W-521 design will provide pressure measurement at the discharge of the transfer pumps. Pressure instrumentation will be specified in detailed design. Standard industrial pressure elements, transmitters, and receiving devices (PLCs) will meet the requirements stated in HNF-4155.

4.9 Closed Circuit Television (CCTV)

CCTVs have been used at Hanford for several years. Reference the W-521 CCTV Evaluation for further information related to requirements and recommendations.

4.9.1 Reference "W-521 CCTV Evaluation" that addresses requirements and recommendations.

Vendor Search for Small Camera System for Project W-521, Waste Feed Delivery Systems, Report Number 990920203-016, Rev. 0.

4.9.2 Summary of RPP-5687, Rev. 0, "Waste Retrieval Sluicing System and Project W-320, Tank 241-C-106 Sluicing, Lessons Learned," dated May 2, 2000 by CH2M HILL Hanford Group, Richland, Washington.

The imaging system used was very helpful initially, but degraded with the environment of the tank during flushing or sluicing. Consideration should be given to an infrared system to eliminate this problem and also to eliminate the lighting system required to facilitate the camera operation. In addition, an alternate imaging system access point should be considered. The present location did not provide a view of certain parts of the tank.

4.9.3 Summary of RPP-6548, Rev. 0, "Preliminary Test Report 241-AZ-101 Mixer Pump Test," dated July 17, 2000 by CH2M HILL Hanford Group, Richland, Washington.

While in service, the camera provided excellent input. The expected life of the camera was predicted to be 2000 hours. As the camera was being panned, it was bumped into a thermocouple installed in a riser adjacent to riser 16B. The camera was removed, repaired, and returned to service. The camera failed for the second and last time three weeks after it was initially put into service. It was thought that the camera failed due to moisture accumulation in the mast assembly.

4.9.4 Recommendation for CCTV

Reference the W-521 CCTV Report, *Vendor Search for Small Camera System for Project W-521, Waste Feed Delivery Systems*, Report Number 990920203-016, Rev. 0.

4.10 In-Line Viscosity Measurement

There were several attempts, without success, to develop and test instrumentation that would be capable of measuring viscosity during waste transfers.

4.10.1 In-Line Viscosity Measurement Requirements

There are no in-line viscosity measurement requirements identified for Project W-521.
There are no anticipated requirements for in-line viscosity measurement.

4.10.2 Summary of "Waste Tank Slurry Technology Development and Testing Overview," dated October 13, 1999 by Ron Bafus, Numatec Hanford, Richland, Washington.

Considerable testing of in-line viscometers has been conducted at SRS, ORNL, and Hanford over the last 15 years. No commercial device has been found acceptable. Two prototype devices cold tested by ORNL as part of CMST-CP have promising potential but need further development to become more reliable and to be able to operate under the conditions found in waste transfer lines.

4.10.3 Recommendations to the In-Line Viscosity Measurement

At this time W-521 is not considering in-line viscosity measurement as a viable parameter to measure.

4.11 General Considerations

This section is used to capture additional lessons learned from project W-320.

4.11.1 Summary of RPP-5687, Rev. 0, "Waste Retrieval Sluicing System and Project W-320, Tank 241-C-106 Sluicing, Lessons Learned," dated May 2, 2000 by CH2M HILL Hanford Group, Richland, Washington.

4.11.1.1. Booster Pump Seal/Seal Gas Control System Problems

High gas injection rates caused problems for the slurry line mass flow meter. This was previously discussed in the mass flow meter section of this document. If possible, new pump designs should consider using water seals instead of gas seals.

Installation of a differential pressure gas seal or water seal control system would overcome the need for manual adjustments to the seal gas pressure to account for various system operating pressure conditions.

The additional cost of a differential pressure controlled seal gas system would be offset many fold by the reduction in the maintenance costs for manually adjusting the system.

4.11.1.2. Expanded Computer Process Control/Data Logging

The human-machine interface, comprised of a desktop computer running Citech software, was added to the scope of the project late in the project's development. The computer system was added as a cost savings measure. It was obvious that time could have been saved if additional process data were logged by the system for subsequent analysis [i.e. booster pump inlet pressure and amps, winch height, sluice fluid flow rate, Standard Hydrogen Monitoring System (SHMS) hydrogen levels].

4.11.1.3. Data Reports Available on the Internet

Process control data from the sluicing operation was posted on a web page, which allowed for review by technical experts to ensure that the Authorization Basis and Process Control Plan had been met.

The W-521 RCS will have the capability to meet the suggestions listed above. Also, as previously mentioned, W-521 is working on specifying pump seals that do not incorporate gas seals.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Further analysis is required to determine if in-line density measurement from various pump suction levels during the waste feed delivery process would provide useful data.

If space becomes an issue in the pit, then the Endress and Hauser mass flow meter should be considered because of its smaller size. Standard industrial coriolis flow meters meet the requirements stated in HNF-4155.

The instrumentation that will be specified will be a proven technology that meets the requirements of HNF-4155.

The following is a recommended list of additions to the Project W-521 conceptual design based on the conclusions from this evaluation.

- Project W-521 RCS should connect to the insulating concrete thermocouples. This will provide additional data that will be helpful in determining sludge mobilization.
- If possible, W-521 should specify pump seals that do not require gas.
- Project W-521 will monitor SHMS parameters for those tanks that have a SHMS installed.

- The instrumentation that indicates the position of the mixer pump needs to be calibrated or biased before put in use in the tanks. This should be stated as a capability of the instrumentation and as installation criteria.

- Reference the W-521 CCTV Report (*Vendor Search for Small Camera System for Project W-521, Waste Feed Delivery Systems*, Report Number 990920203-016, Rev. 0.) for recommendations.

The additional costs associated with these activities have been accounted for in the overall estimate associated with Subtask 14, Existing Interface Requirements.

6.0 REFERENCES

RPP-5687, Rev. 0, 3-2-00, "Waste Retrieval Sluicing System and Project W-320, Tank 241-C-106 Sluicing, Lessons Learned", CH2M HILL Hanford Group, Richland, Washington.

HNF-4379, Rev. 1, 6-29-99, "Waste Retrieval Sluicing System Campaign Number 1 - Solids Volume Transferred Calculation", Lockheed Martin / Hanford Corporation, Richland, Washington.

RPP-6548, Rev. 0, 7-17-00, "Preliminary Test Report 241-AZ-101 Mixer Pump Test", CH2M HILL Hanford Group, Richland, Washington.

"WASTE TANK SLURRY TECHNOLOGY DEVELOPMENT AND TESTING OVERVIEW" dated October 13, 1999 by Ron Bafus, Numatec Hanford, and Richland, Washington.

HNF-4155, Rev. 0, 4-27-00, DST Monitor & Control Subsystem Specification, CH2M HILL Hanford Group, Richland, Washington.

HNF-5145, Rev. 0, 6-14-00, "High-Level Waste Feed Process Control Strategy", CH2M HILL Hanford Group, Richland, Washington.

HNF-5146, Rev. 0, 6-14-00, "Low-Activity Waste Feed Process Control Strategy", CH2M HILL Hanford Group, Richland, Washington.

Appendix A
Requirements from the DST Monitor and Control Subsystem Specification
Document No. HNF-4155

This appendix is an excerpt from the document HNF-4155, "DST Monitor & Control Subsystem Specification" which describes the equipment characteristics that are currently specified for instrumentation in project W-521. This specification is currently being revised, and it is anticipated that the new revision will be released in September 2000.

3.2 CHARACTERISTICS

This section contains the minimum requirements related to performance characteristics, physical characteristics, reliability, maintainability, environmental conditions, transportability, and flexibility and expansion. Minimum requirements are identified by SHALL statements, while design goals are identified by SHOULD statements. If a requirement with a "should" statement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

3.2.1 Performance Characteristics

This Section contains requirements related to the functionality and performance capabilities for the DST Monitor and Control Subsystem.

3.2.1.1 Monitor Double Shell Tank Structure Temperature. The performance characteristics for the following have not been determined as of yet:

3.2.1.1.1 Receive DST Structure Temperature.

3.2.1.1.2 Compare DST Structure Temperature.

3.2.1.1.3 Record DST Structure Temperature.

3.2.1.1.4 Display DST Structure Temperature.

3.2.1.1.5 Respond to Off-Normal DST Structure Temperature.

3.2.1.2 Monitor Double-Shell Tank Waste Temperature.

The DST instrument and control component of the DST Monitor and Control Subsystem shall monitor DST waste temperature to determine if operating limits are being exceeded. Monitoring includes measuring tank waste temperature and transmitting the data to the DST Monitor and Control Subsystem and/or the Tank Monitoring and Control System (TMACS), which will receive, record, display, and compare the waste-level data with operational limits.

Temperature sensor probes:

- Range: -10 to 200 °C (14 to 392 °F). These values may be revised.
- Resolution: 0.55 °C (1 °F)
- Loop accuracy: ± 2.8 °C (± 5 °F).

3.2.1.3 Monitor Double-Shell Tank Waste Level

The DST instrument and control component of the DST Monitor and Control Subsystem shall monitor the DST liquid waste levels. Monitoring includes measuring waste levels and transmitting the data to the DST Monitoring and Control Subsystem and/or the TMACS that will receive, record, display, and compare the waste level data with operational limits:

- Range: 0- to 1072 cm (0- to 422 in.) AN, AP, AW, and SY tanks
- Range: 0- to 940 cm (0- to 370 in.) AY and AZ tanks
- Resolution: + 0.03 cm (0.1 in.)
- Loop accuracy: + 0.6 cm (1/4 in.).

3.2.1.13 Monitor Process Parameters for Waste Transfers

3.2.1.13.1 Receive Waste Transfer Flow (Mass/Volumetric) Rate. The DST Monitor and Control Subsystem shall receive waste transfer flow rate data from Transmit Waste Transfer Flow Rate function. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit the waste flow rate at the transfer pump discharge.

3.2.1.13.2 Compare Waste Transfer Flow Rate Data. The DST Monitor and Control Subsystem shall compare waste transfer flow rate data received by the Receive Waste Transfer Flow Rate function to operational limits to initiate an alarm of off-normal flow and/or provide automatic flow control, as required.

a. Monitoring and control of the waste transfer flow rate will be programmed into the PLC, including proportional, integral, and derivative (PID) algorithms.

b. Flow rate (mass flow and volumetric flow) loop accuracy shall be +5 percent of process range.

3.2.1.13.3 Record Waste Transfer Flow Rate. The DST Monitor and Control Subsystem shall record waste transfer flow data.

a. The DST Monitor and Control Subsystem shall record transfer pump flow rate continuously (mass flow and volumetric flow).

3.2.1.13.4 Display Waste Transfer Flow Rate. The DST Monitor and Control Subsystem shall display waste transfer flow rate received by the Receive Waste Transfer Flow Rate function. The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the waste transfer annunciator set of master pump shutdown machine interface graphical screens. Flow-rate range is 0- to 757 L/min (0- to 200 gal/min). This value may be revised.

3.2.1.13.5 Respond to Abnormal Transfer Flow Rate. The DST Monitor and Control Subsystem shall respond to abnormal waste transfer flow which has not yet been determined.

3.2.1.14 Monitor Transfer Pump Discharge Pressure

3.2.1.14.1 Receive Transfer Pump Discharge Pressure. The DST Monitor and Control Subsystem shall receive transfer pump discharge pressure from the Transmit Transfer Pump Discharge Pressure Data function.

a. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit transfer pump discharge pressure.

3.2.1.14.2 Compare Transfer Pump Discharge Pressure Data. The DST Monitor and Control Subsystem shall compare waste transfer pump discharge pressure data with operational limits. Pressure loop accuracy shall be ± 5 percent of process range.

3.2.1.14.3 Record Transfer Pump Discharge Pressure Data. The DST Monitor and Control Subsystem shall record transfer pump discharge pressure data. The DST Monitor and Control Subsystem shall continuously record transfer pump discharge pressure.

3.2.1.14.4 Display Transfer Pump Discharge Pressure Data. The DST Monitor and Control Subsystem shall display transfer pump discharge pressure data.

a. The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the waste transfer annunciator set of master pump shutdown machine interface graphical screens.
b. Pressure range is 0- to 5960 kPa (0- to 850 lbf/in2). This value may be revised.

3.2.1.14.5 Respond to Abnormal Transfer Pump Discharge Pressure. The DST Monitor and Control Subsystem shall respond to abnormal pump discharge pressure.

a. The transfer pump shall have a discharge pressure High-High interlock.

3.2.1.15 Monitor Waste Transfer Density/Temperature

3.2.1.15.1 Receive Waste Transfer Density/Temperature Data. The DST Monitor and Control Subsystem shall receive the Waste Transfer Density/Temperature Data from the Transmit Waste Transfer Density/Temperature Data function.

a. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit waste density (and temperature) at the transfer pump discharge.

3.2.1.15.2 Compare Waste Transfer Density/Temperature Data. The DST Monitor and Control Subsystem shall compare waste density/temperature data with operational limits.

a. Density shall have a loop accuracy of +5 percent of process range.

b. Temperature shall have a loop accuracy of +2.8 oC (+5 oF).

3.2.1.15.3 Record Waste Transfer Density/Temperature Data. The DST Monitor and Control Subsystem shall record waste density data received by the Receive Waste Transfer Density/Temperature Data function.

a. The system shall continuously record density and temperature of waste being transferred.

3.2.1.15.4 Display Waste Transfer Density/Temperature Data. The DST Maintenance and Control Subsystem shall display waste density/temperature data.

a. The dynamic analog data associated with waste transfer routes shall be displayed on the waste transfer annunciator set of master pump shutdown HMI graphical screens.

b. Density range is 0.9000 to 1.5000 g/cm3 with an accuracy of 0.0005 g/cm3. This could be revised.

c. Temperature range is –10 to 200 oC (14 to 392 oF) with an accuracy of +2.8 oC (+5 oF).

3.2.1.15.5 Respond to Abnormal Density/Temperature Data. The DST Monitor and Control Subsystem shall respond to abnormal waste density/temperature, which has yet to be determined.

3.2.1.18 Perform Material Balance for Double-Shell Tank Transfers

The DST Monitor and Control Subsystem shall provide data that will be used to perform material balance periodically during the waste transfer to determine that the amount of waste being delivered to the destination agrees with the amount of waste being removed from the source tank.

a. Accuracy: +0.6 cm (+1/4 in.) in sending and receiving tank plus transfer line volume as applicable for tank level to tank level material balance.

b. Accuracy: +5 percent of range for flow and +0.6 cm (+1/4 in.) for level for totalized flow to tank level comparison.

3.2.1.20 Operate Mixer Pump

Transmit Operate Mixer Pump Command. DST Monitor and Control Subsystem shall transmit operate mixer pump command as a control signal input for initiating, modifying, or halting the mixer pump operation. This function is provided to the Receive Operate Mixer Pump Command function.

a. All pump auto/manual, on/off, and start/stop selections and indications will be provided to the monitoring system.

3.2.1.21 Monitor Mixer Pump Operation. DST Monitor and Control Subsystem shall provide indication of the mixer pump operational parameters.

3.2.1.21.1 Receive Mixer Pump Operation Data. DST Monitor and Control Subsystem shall receive data from the Transmit Mixer Pump Operation Data function.

a. Instrumentation shall provide the following monitoring and control functions for the mixer pump: motor speed and amperage, motor bearing temperature, motor stator winding temperature, turntable rotation and orientation, pump vibration, and nozzle discharge pressure. Signal scaling has yet to be determined.

3.2.1.21.2 Compare Mixer Pump Operational Parameters Data. DST Monitor and Control Subsystem shall compare mixer pump operational parameters with operational limits. Interlocks will be provided to prevent equipment damage or harm to the environment or personnel (this implies that a pump parameter is compared with an operational limit). Operational limits have yet to be determined.

3.2.1.21.3 Record Mixer Pump Operation Data. DST Monitor and Control Subsystem shall record mixer pump operation data.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending (recording) of process parameters with report capability for a period of one week.

3.2.1.21.4 Display Mixer Pump Operation Data. DST Monitor and Control Subsystem shall display mixer pump operation data.

a. The DST Monitor and Control Subsystem shall provide indication of monitored parameters. Ranges and resolution have yet to be determined.

3.2.1.21.5 Respond to Abnormal Mixer Pump Operation Data. DST Monitor and Control Subsystem shall respond to off-normal mixer pump operational parameter by providing mixer pump shutdown interlocks.

a. Shut down mixer pump for the following reasons:

- Motor Vibration (High-High)
- Motor current (High-High)
- Motor winding temperature (High-High)
- Bearing temperature (High-High)
- Off-normal values which have yet to be determined.

3.2.1.22 Double-Shell Tank Utilities Function. These parameter have yet to be determined.

3.2.1.22.1 Receive Service Water Totalized Flow

3.2.1.22.2 Compare Service Water Totalized Flow Data

3.2.1.22.3 Record Service Water Totalized Flow Data

3.2.1.22.4 Display Service Water Totalized Flow Data

3.2.1.22.5 Respond to Abnormal Service Water Totalized Flow Data

Appendix B
W-521 Mixer Pump 1 (Riser 1C) Fixed Position ECR Testing Results Table and W-521 Mixer Pump(s) Oscillating ECR Testing Results Table

Table 5. *Mixer Pump 1 (Riser 1C)* **Fixed Position ECR Testing Results**

T/C Number	Location	Distance from Mixer Pump 1 Center Line (ft)	Starting Thermocouple Temperature (°F)	Ending Thermocouple Temperature (°F)	Ending Average Solution Temperature (°F)
Position A – Riser 15F					
38	ALC #2	7.5	137.3	130.5	
64	Riser 15F	13.9	139.8	132.1	
21	Insul. Concrete	15.6	139.6	130.8	
4	Insul. Concrete	19.0	159.1	130.6	130.1
72	Riser 14C	19.1	138.2	123.6	
37	ALC #1	22.0	153.1	135.1	
1	Insul. Concrete	28.1	157.5	130.8	
Position C – Riser 15E					
11	Insul. Concrete	6.4	146.1	133.3	
46	ALC #10	7.4	142.3	129.7	
61	Riser 15E	20.5	146.1	133.9	130.6
49	ALC #13	26.0	143.1	130.5	
20	Insul. Concrete	26.8	142.7	133.3	
24	Insul. Concrete	37.4	153.5	131.0	
Position D – Air-Lift Circulator 8					
10	Insul. Concrete	10.7	158.0	134.2	
44	ALC #8	16.5	153.1	131.4	
100	Riser 14F	23.3	136.8	128.2	130.7
23	Insul. Concrete	24.6	140.7	134.8	
9	Insul. Concrete	25.6	157.5	133.3	
58	ALC #22	26.4	142.7	130.8	
Position E – Air-Lift Circulator 2					
22	Insul. Concrete	15.6	139.8	130.6	
3	Insul. Concrete	16.6	156.9	132.1	
37	ALC #1	22.0	137.3	132.6	130.6
2	Insul. Concrete	26.5	162.1	132.8	
43	ALC #7	29.4	139.5	132.3	

Table 6. Mixer Pump(s) Oscillating ECR Testing Results

T/C Number	Type	Distance from Mixer Pump Center Line (ft)	Starting Thermocouple Temperature (°F)	Ending Thermocouple Temperature (°F)	Ending Solution Temperature (°F)
Mixer Pump 1 – Oscillating at 700 rpm					
40	ALC	28.9	151.9	130.8	130.6
Mixer Pump 1 – Oscillating at 1000 rpm					
5	Insulating Concrete	34.5	157.5	134.8	131.7
Mixer Pump 1 – Oscillating at Maximum Speed					
8	Insulating Concrete	37.0	146.5	134.2	133.1
Mixer Pumps 1 and 2 – Oscillating at 700 rpm					
5	Insulating Concrete	34.5 [Pump 1]	152.6	130.8	130.1
8	Insulating Concrete	21.9 [Pump 2]	152.2	130.8	130.1
Mixer Pumps 1 and 2 – Oscillating at 1000 rpm					
19	Insulating Concrete	37.4 [Pump 1]	142.2	132.8	131.4
51	ALC	26.4 [Pump 2]	172.8	132.8	131.4
Mixer Pumps 1 and 2 – Oscillating at Maximum Speed					
19	Insulating Concrete	37.4 [Pump 1]	-[1]	-[1]	-[1]
18[2]	Insulating Concrete	37.4[Pump 2]	145.6	142.9	142.2

Notes:

[1] This thermocouple was previously cleared when pumps 1 & 2 were oscillating at 1000 rpm.

[2] This thermocouple did not clear during the section of the OTP being performed for ECR testing (section 5.8). This thermocouple did clear while performing the settling testing section of the OTP. Temperatures reflected are during settling testing.

3.2.2 Maximum Sludge Suspension

Determining the volume and concentration of sludge suspended by operation of mixer pumps at maximum speed is based primarily on laboratory analysis of grab samples. Grab sample event 4, 5 and 6 were acquired after operation of both mixer pumps at maximum speed for at least a 24-hour period. Completed laboratory analysis of these grab samples providing quantitative estimates of the maximum sludge mobilization was not yet available during preparation of this preliminary report. Quantitative interpretation of instrumentation readings taken during the test will also require quantitative comparison to the future laboratory analyses.

Appendix C
W-521 Graphs for URSILLA, SSP, and GAMMA Monitoring

Figure 20. URSILLA Profiles from Riser 5B During Settling Testing (1-14 Hours After Pump Shutdown)

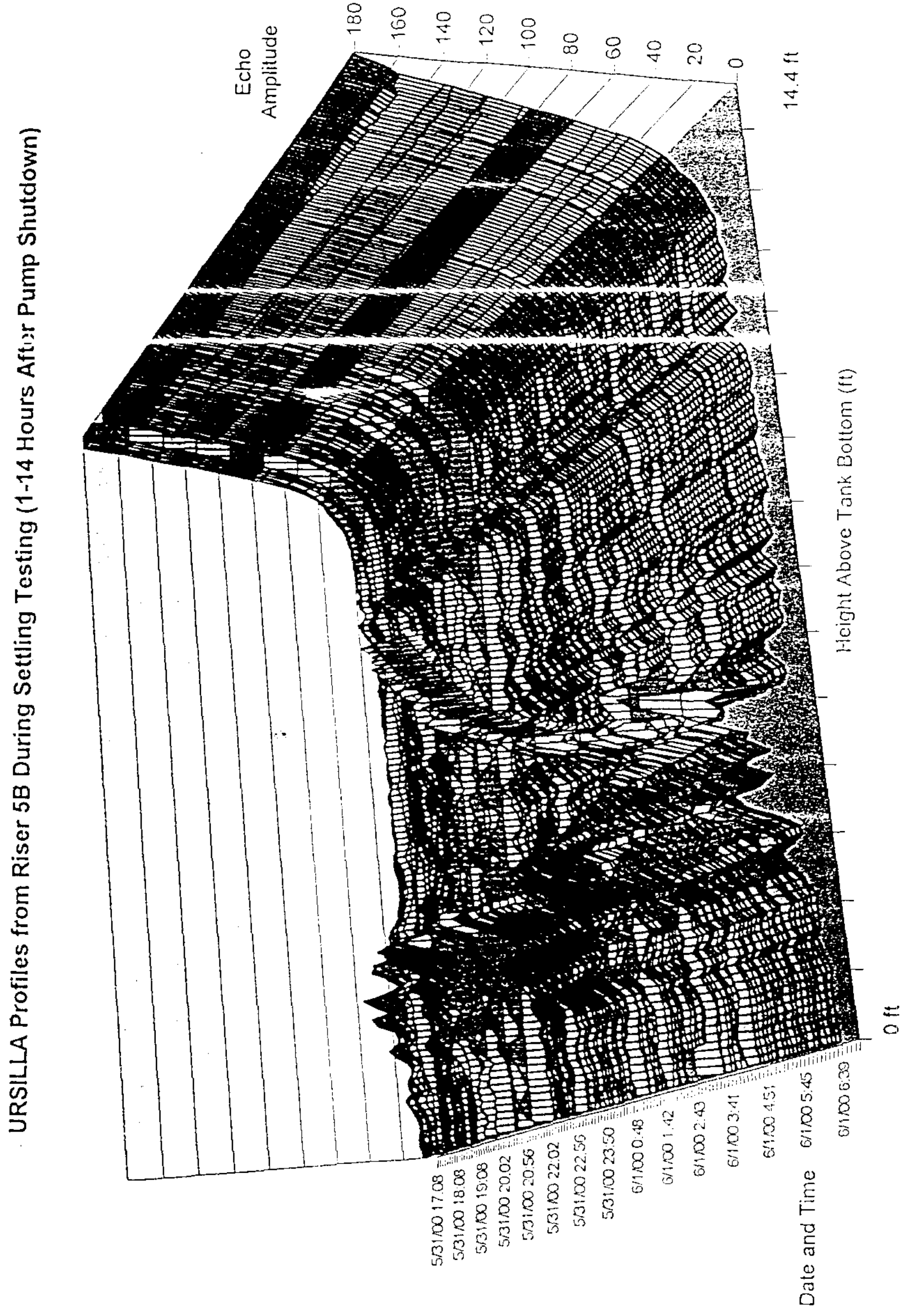


Figure 18. SSP Solids Concentration During Settling Testing (8-48 Hours After Pump Shutdown)

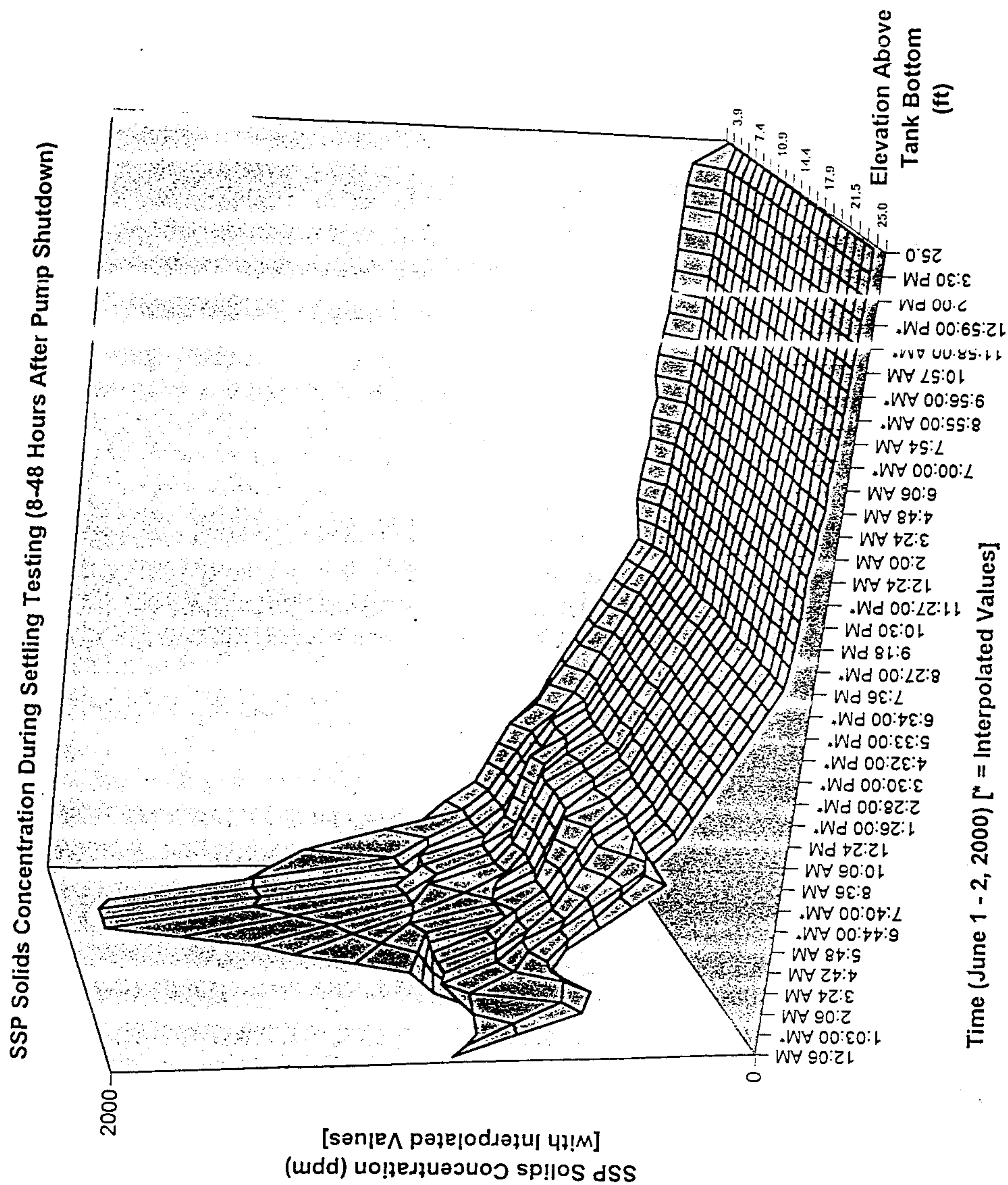
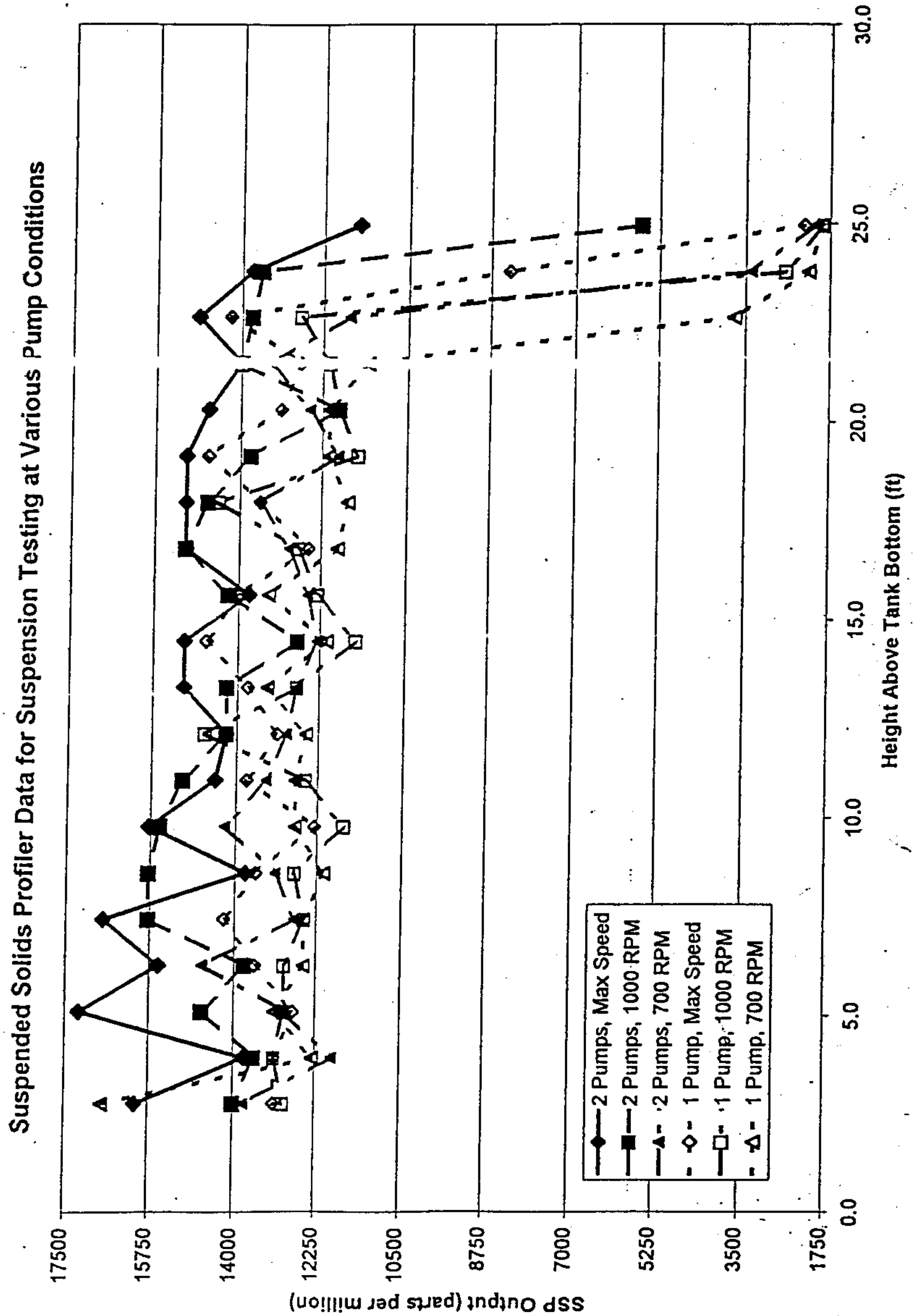
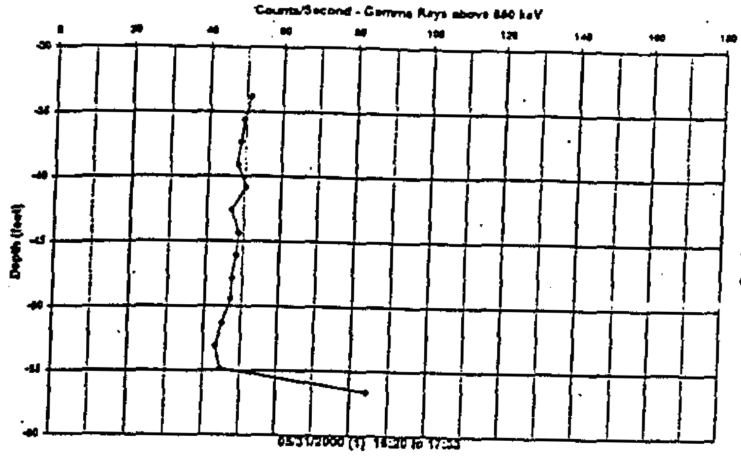
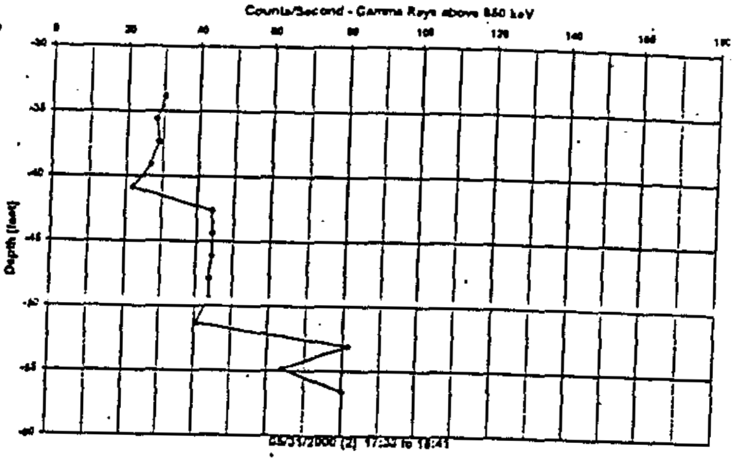
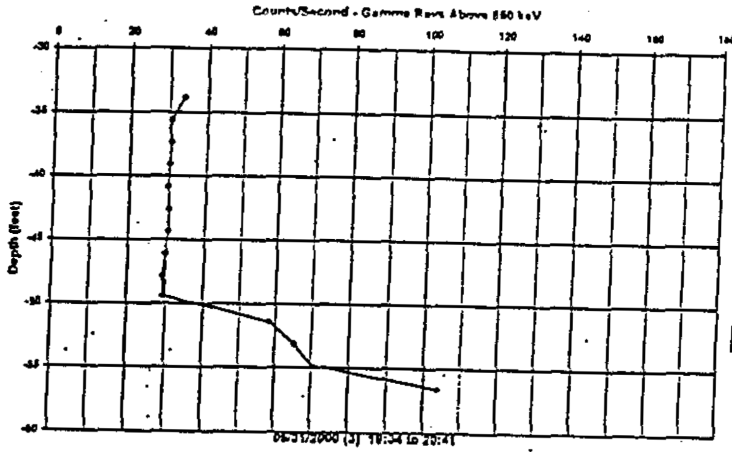


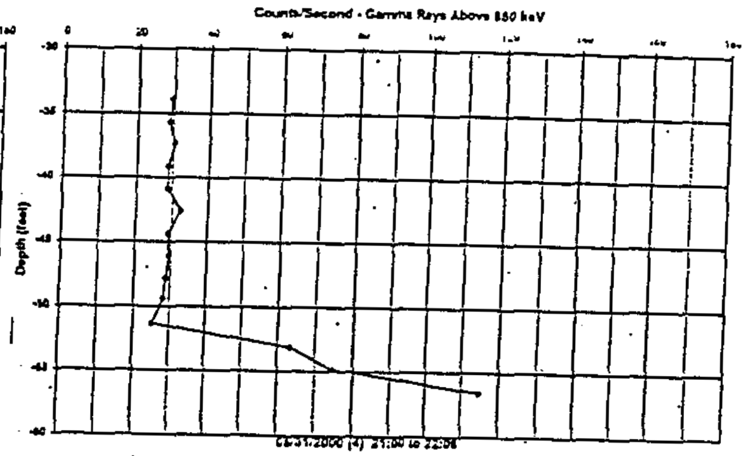
Figure 17. SSP Data for Suspension Testing at Various Pump Conditions

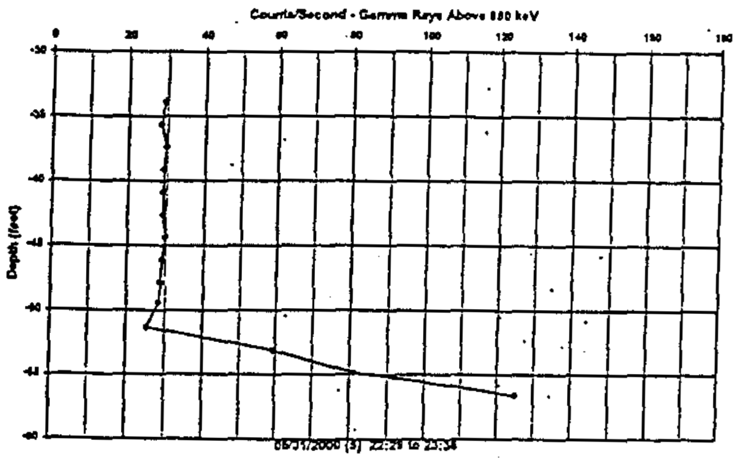


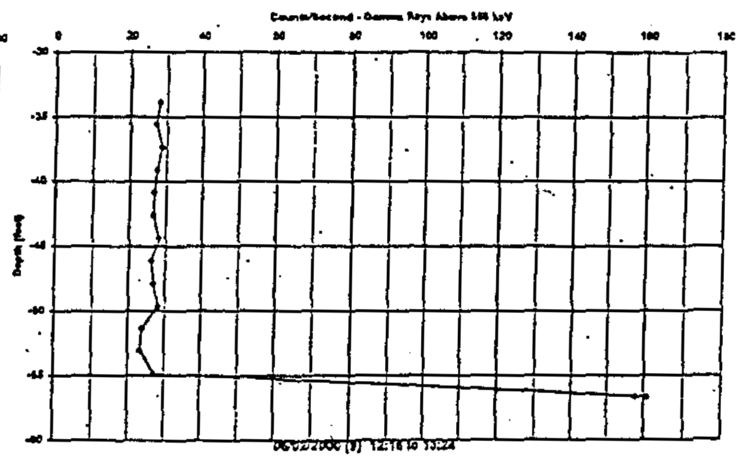












GAMMA MONITORING

Attachment L

Attachment L

Reuse of Long-Length Contaminated Equipment Components

REUSE OF LONG-LENGTH CONTAMINATED EQUIPMENT COMPONENTS

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-007
ACDR Subtask 12
Revision 0

September 2000

prepared by

The HND Team

REUSE OF LONG-LENGTH CONTAMINATED EQUIPMENT COMPONENTS

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September 2000

Prepared by: Dave Haring
Steve Riesenweber

Approved by: R L Fritz for
Larry Shipley, P.E.

Date: 9-29-00

Table of Contents

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Tables

Acronyms

ACD	Advanced Conceptual Design
CDR	Conceptual Design Report
FRA	Flexible Receiver Assembly
LLCE	Long-Length Contaminated Equipment
RCRA	Resource Conservation and Recovery Act of 1976
TRUM	Transuranic Mixed Waste

1.0 INTRODUCTION

Project W-521 will install new transfer pumps, mixer pumps, camera systems, and instrumentation in several tanks associated with waste feed delivery. To support this activity, much of the currently installed in-tank equipment will need to be removed and disposed of. It has been determined that much of the Long-Length Contaminated Equipment (LLCE) will be disposed of using the LLCE disposal system. This system comprises a cradle to grave process for the retrieval, characterization, packaging, treatment, and disposal of radioactive mixed waste removed from tanks. Long-length equipment is defined as components greater than 12 ft in length that cannot be placed in a standard burial box without cutting. The current CDR cost estimates assume that a large amount of "consumables" are required for each LLCE item to be removed.

1.1 Purpose

The purpose of this document is to:

- Refine the list of items to be removed from each tank based on the results of other ACD tasks.
- Evaluate the existing LLCE system and determine if improvements in equipment design or operating philosophy could be made which would reduce project costs.
- Identify components that could more cost effectively be disposed in standard burial boxes rather than via the LLCE disposal system thereby reducing project costs.

1.2 Scope

The scope of this document includes evaluation of the LLCE system as it pertains to the in-tank equipment identified for removal by the W-521 project in the tanks listed below.

- 241-AW-101
- 241-AW-103
- 241-AW-104
- 241-AY-101
- 241-AY-102
- 241-SY-101
- 241-SY-102
- 241-SY-103

2.0 METHODOLOGY

The approach used to accomplish the overall task involved dividing the work into the subtasks described below.

- Identify Equipment to be Removed – Project costs associated with removal of in-tank equipment is dependent on the quantity and type of equipment being removed. A comprehensive equipment removal list was compiled.

- Identify Removal Method – The cost associated with removal and disposal of in-tank equipment depends on the retrieval method used. The equipment identified for removal was evaluated to determine the optimum method of retrieval.

- Determine Configuration of Associated Riser/Pit – The riser/pit configuration associated with LLCE determines the LLCE System components required to perform a specific retrieval operation. Applicable configuration drawings were refined.

- Identify the primary LLCE System Components Required – Each item of LLCE being removed requires a specific configuration of LLCE system components. This configuration depends on the riser/pit size and the type of equipment being removed. A list of the primary LLCE system components required for each LLCE identified for removal was compiled.

- Evaluate Identified LLCE System Components – The LLCE system components were individually evaluated to determine if improvements could be made that would reduce the project costs associated with LLCE removal. The primary goal was to minimize the amount of consumables required through component standardization and changes in operating philosophy.

3.0 ASSUMPTIONS

The following assumptions were used in the development of this report:

- Equipment that is waste intrusive or was previously waste intrusive is assumed to be radioactive mixed waste;

- Equipment that is dome intrusive, but not waste intrusive, and has not come into contact with tank waste will be treated as radioactive waste (not mixed waste) and disposed of in burial boxes using standard Tank Farm bagging and disposal procedures;

- Equipment that is dome intrusive but not waste intrusive but has come into contact with tank waste will be treated as radioactive mixed waste and disposed of in burial boxes using standard Tank Farm bagging and disposal procedures.

4.0 DISCUSSION

4.1 LLCE System Overview

Prior to mobilization of any equipment, preliminary characterization of the waste LLCE will be performed. The most recent tank waste characterization information along with the physical attributes of the equipment to be removed will be processed in the PC-based LLCEDATA program. This program will identify the proper burial container and Flexible Receiver Assembly (FRA). This program will also prepare a data file that will be used in conjunction with radiological assay data gathered during equipment retrieval to confirm that the waste falls within the bounds established in the LLCE Waste Certification Summary. Waste will be classified as radioactive mixed waste or transuranic mixed waste (TRUM).

Retrieval of LLCE is accomplished using a mobile crane and a FRA. This system provides a means of remotely retrieving equipment from a riser into a flexible receiver bag, which is sealed and "double bagged" on the bottom end. A spray wash assembly washes the equipment externally with a 3,000 psi hot water spray prior to the equipment entering the FRA. Equipment such as pumps is flushed internally after being raised above the waste level. A gamma assay is performed along the length of the equipment as it is being removed. This data is used to verify the waste classification of the equipment being removed. Figure 4-1 provides a diagram of the FRA System.

Two sizes of FRAs have been designed. The 4/6-in. device is for use on small, above grade risers containing such equipment as thermocouple trees and instrumentation trees. The other 42-in. unit is for use on larger risers (12-in., 34-in., and 42-in.) contained in pits that hold equipment such as transfer and mixer pumps.

The FRA system uses platforms and adapters, to conform to the varying physical configurations found at the different Tank Farms and Double-Contained Receiver Tanks.

The LLCE Receiver Trailer (Figure 4-2) will be positioned in the Tank Farm adjacent to the crane and FRA. Its function is to receive the bagged equipment in a half-shell skid assembly while it is still in a vertical position, transition it safely to a horizontal position, and act as the vehicle to move the equipment to a location for packaging.

Once waste equipment is transitioned to horizontal, the Receiver Trailer is moved to a nearby packaging/staging area where the LLCE Transport Trailer (Figure 4-3) is located with a burial container secured in place. Nine container sizes have been identified to contain at least 98 percent of all LLCE. Eight of the nine sizes of containers have been designed and tested. The two trailers are remotely aligned and a tug assembly moves the equipment and skid into the polyethylene burial container. The container lid is then positioned and welded in place using electrical heating elements incorporated into the container lid.

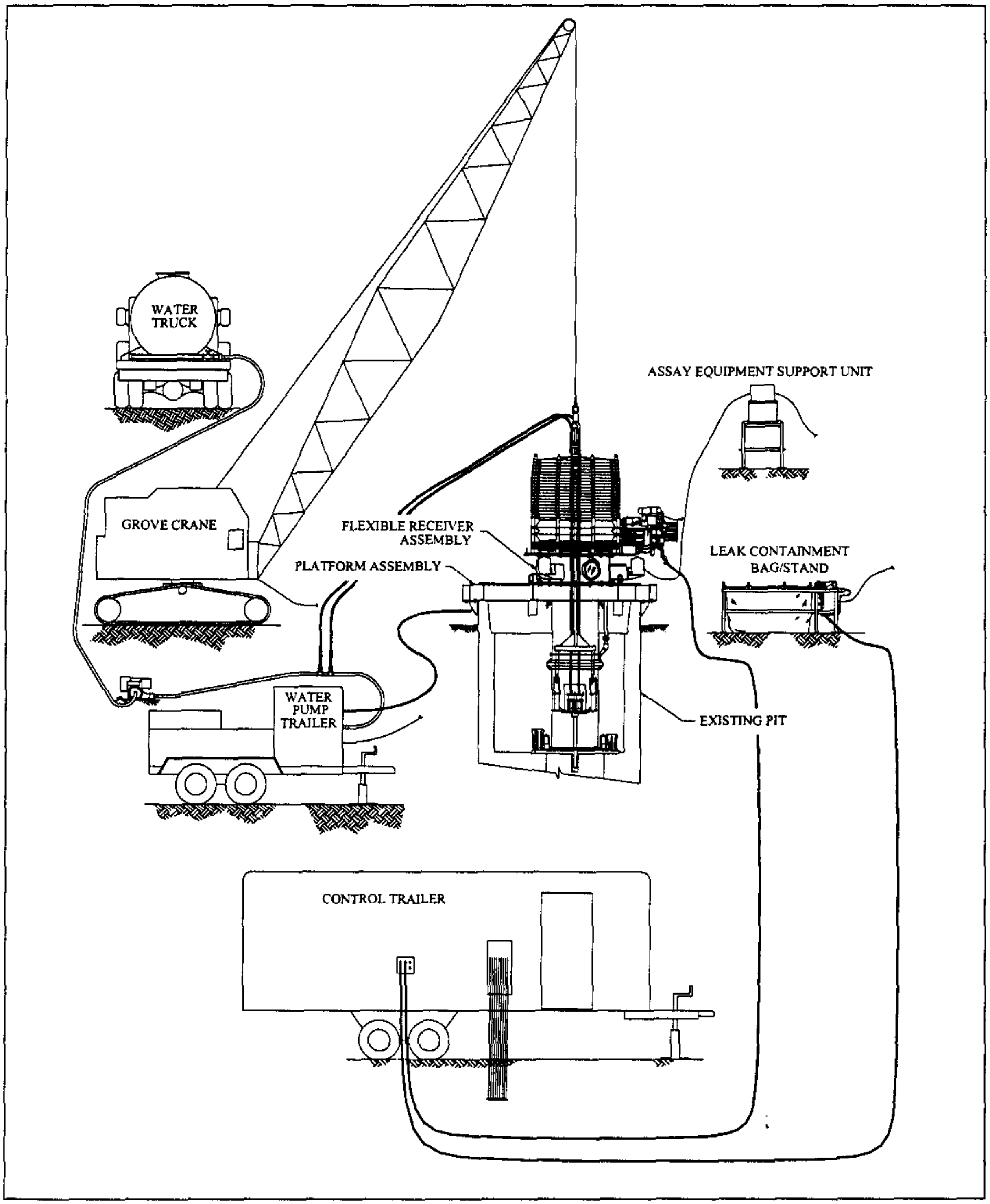

Figure 4-1. FRA System.

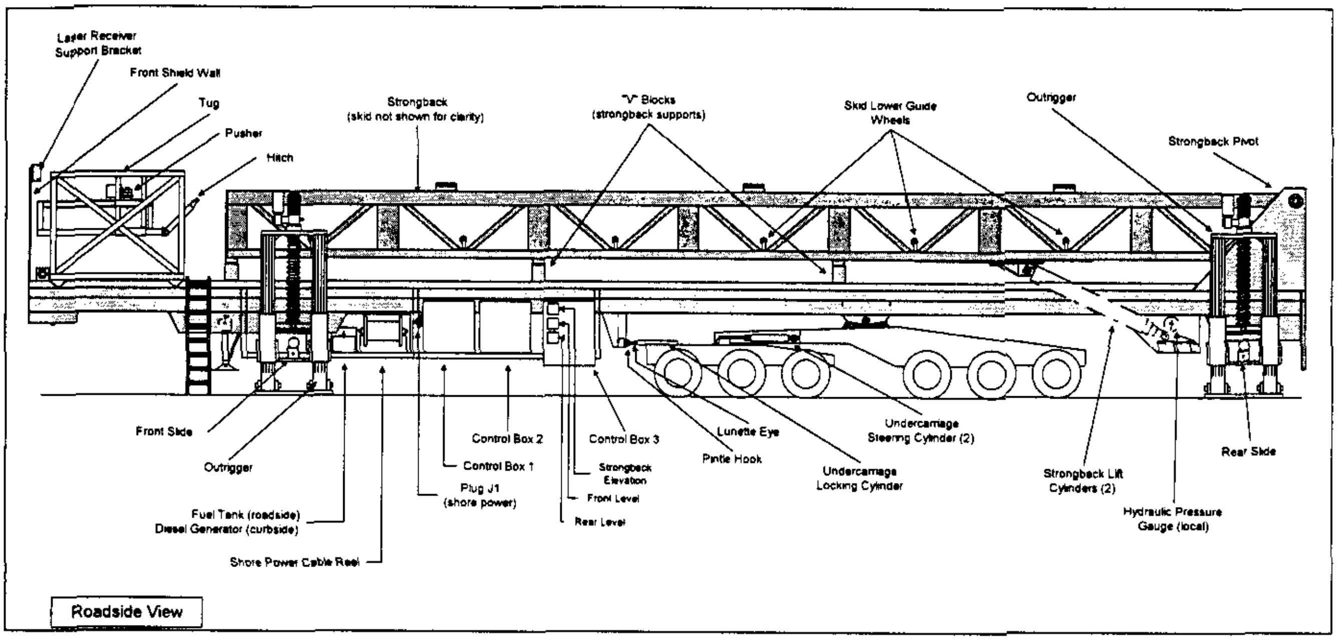

Figure 4-2. LLCE Receiver Trailer.

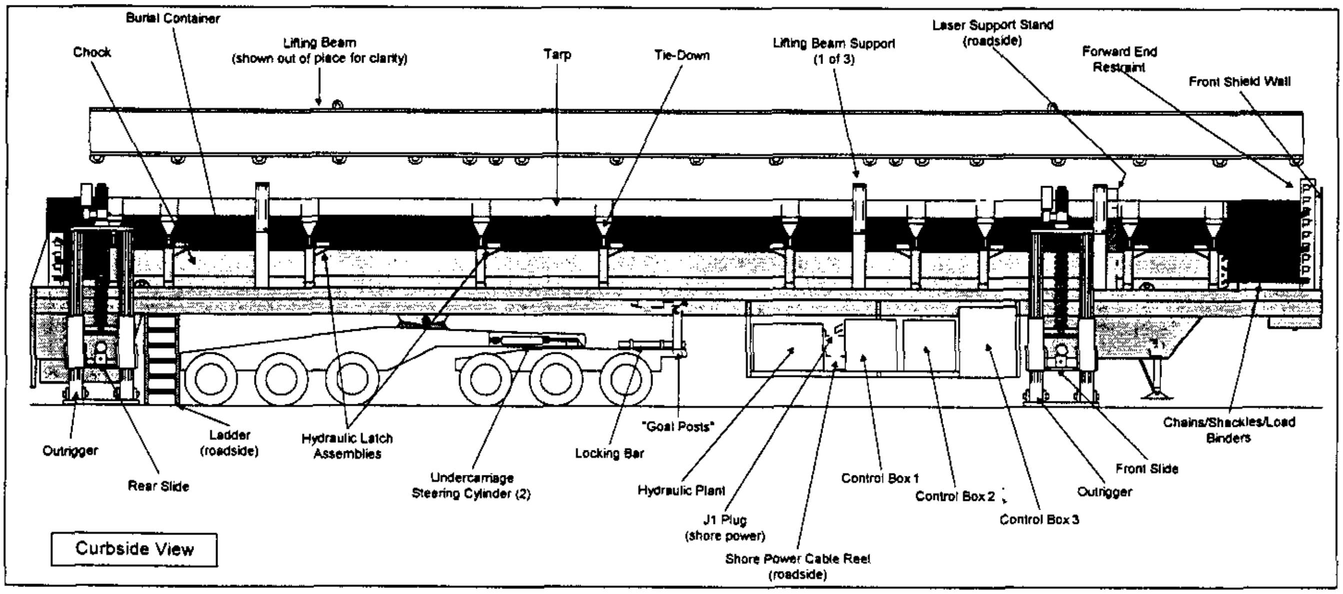

Figure 4-3. LLCE Transport Trailer.

The data file output from the FRA gamma assay equipment compiled during retrieval is input with the LLCEDATA computer program output data into the LLCECALC program. This program analyzes the information to verify and ensure compliance with transportation and disposal requirements specified in the Safety Analysis Report for Packaging, and the Waste Certification Summary.

As long as the LLCECALC program verifies that the waste is not suspect TRUM and that excess hydrogen gas will not be generated, the waste item can be treated per Resource Conservation and Recovery Act of 1976 (RCRA) requirements for disposal in the mixed waste landfill trenches located in the 200 West Area. "Macro-encapsulation" has been determined to be the most cost effective treatment approach (ARES 1998). This process involves filling the polyethylene burial container with low-density perlite grout to completely encase the LLCE. Then the grout and vent ports are sealed and leak tested and the package is ready for shipment to the mixed-waste trench.

The Transport Trailer holding the disposal container has been specially designed to accommodate the heavy load associated with a grout filled container and to maneuver through the Site roads. This is accomplished through the use of multiple axles with steerable bogey's on the rear.

A SARP has been released for the family of burial containers that provides a single safety analysis for the transport of containerized LLCE waste. The SARP bounds the waste that may be transported for routine operations. If contamination levels or constituents are found to exceed the bounding limits of the SARP, an Engineering Change Notice will be written against this document or a single use Safety Evaluation for Packaging (SEP) can be generated prior to shipment. These documents place vehicle speed, environmental, and administrative controls on the transport process.

The destination for transport is dependant upon the results of the LLCECALC program. If the waste turns out to be suspect TRUM, or hydrogen generation rates are too high, it cannot be disposed in the mixed-waste trench. In this case, it will be taken to the Central Waste Complex for storage and eventual alternative treatment. Equipment will be extensively flushed internally and externally (if component internals are exposed to the waste) and assayed. Washing will continue until LLCE is below TRU limits therefore, equipment removed is not expected to have this classification. Equipment that is determined to not be TRUM will be transported directly to the mixed-waste trench. The majority of the waste will be off-loaded into one of the two existing mixed-waste trenches. A more complete description of the LLCE process is contained in the LLCE Disposal Process Path Document (ARES 1998).

4.2 System Evaluation

4.2.1 In-Tank Equipment to be Removed

New equipment and components will be installed in the tanks within the scope of Project W-521. Criteria was developed by the project for determining which existing in-tank components would require removal. Factors such as the future role of existing equipment, effects of mixer pump forces, and available riser space, and were considered primary in making these determinations. The following is a discussion of this criteria:

- **Component Made Obsolete**

  New transfer pumps, mixer pumps, cameras, and thermocouple trees are being installed in the tanks to ensure reliable waste feed delivery. This new equipment will in some cases perform the same function as existing installed equipment. The existing equipment will be obsolete and considered waste at this point, requiring removal. Installed equipment that was abandoned in place prior to this project will not be removed unless the riser space is needed for Project W-521 equipment.

- **Impingement Forces**

  New mixer pumps are being installed in the tanks associated with this project. These pumps are capable of generating significant forces, due to jet impingement, on waste intrusive equipment in the vicinity of the pumps. An impingement force study was performed (HND 2000a) to determine the affects of theses forces on the existing components as well as on the new equipment being installed by this project. Existing components that were determined to be at risk of being damaged by the impingement study are identified for removal in this report.

- **Riser Needed**

  The new equipment being installed by this project (mixer pumps, cameras, thermocouple trees, etc) requires a larger diameter riser, in most cases, than the equipment being replaced therefore, it will not be possible to do a one for one replacement of components using the same risers. Previously abandoned/obsolete equipment or equipment installed in an oversized riser (i.e. 4-in. level indicator installed on a 6-in. riser) was identified for removal if the riser is required for a Project W-521 component.

Using these criteria, a total of 54 items will require removal by the W-521 project. A mixer pump effectiveness analysis (HND 2000b) was performed to determine the effect of the remaining existing in-tank components and the new project installed components on the mixer pump performance. The detailed list of components identified for removal is contained in Appendix A.

4.2.2 Removal Method

Two primary methods of removing in-tank contaminated equipment have successfully been used in Tank Farms – manual removal and LLCE system. The manual method of removing equipment is routinely performed by Tank Farm Operations for small items. It involves pulling the equipment into a plastic bag or sleeve and then manually shearing the equipment if necessary, to allow disposal in a standard burial box. This method of removal is less expensive from a material and equipment standpoint and generates less secondary wastes than the LLCE System but involves more risk to personnel. For removal of non-waste intrusive equipment (i.e. cameras, slurry distributors, shield plugs) within the scope of the W-521 project, the risk to personnel is relatively low because contamination levels are low; therefore, for this type of equipment using the manual removal method is deemed appropriate. Waste-intrusive equipment such as instrument trees and pumps could in some cases be removed using the manual method; but due to the greater risk associated with equipment with a potential for residual contamination, it was determined that this type of equipment will be removed via the LLCE system.

The configuration of each piece of equipment identified for removal was evaluated to determine the most appropriate method of removal and disposal. This evaluation has determined that 37 items will be retrieved with the LLCE System and 17 will be retrieved using manual methods. Table 4-1 contains a summary of the equipment identified for removal along with the removal method.

4.2.3 Configuration of Associated Riser/Pit

The LLCE System requires the use of adapters to interface with the applicable pits and/or risers; therefore it was necessary to determine the riser/pit configuration for each piece of equipment identified for removal. With respect to the equipment being removed by project W-521, slurry distributors and pumps are the only in-tank equipment currently installed in pits. In-tank instrumentation, drywells, and cameras are installed in tank risers.

The central pump pits in 241-SY and 241-AW are of the same size and configuration. The sluice pits and pump pits in 241-AY are the same within the farm but different from the configuration found in 241-AW and 241-SY. All of the waste-intrusive instrumentation and Liquid Observation Wells (LOWs) being removed by this project are located in 4" diameter risers. A list of the applicable riser and pit drawings associated with each piece of equipment being removed is contained in Appendix A.

4.2.4 Primary LLCE System Components Required

The Receiving/Transport trailers, Groves crane, control trailer, assay equipment, and water pump trailer do not vary with equipment being removed and will be moved to the appropriate tank farm as needed.

Table 4-1. W-521 In-Tank Equipment Removal Matrix

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	EQUIPMENT REMOVAL METHOD
		Tank 241-AW-101	
005	12	Transfer Pump	LLCE System
006	4	Thermocouple Tree	LLCE System
007	42	42" Shield Plug	Burial Box
008	42	Camera/Instruments	Burial Box
012	42	Slurry Distributor	Burial Box
017	4	Multi-Function Instrument Tree	LLCE System
		Tank 241-AW-103	
005	12	Transfer Pump	LLCE System
006	4	Thermocouple Tree	LLCE System
007	42	42" Shield Plug	Burial Box
008	42	42" Shield Plug	Burial Box
012	42	Slurry Distributor	Burial Box
014	4	Liquid Observation Well	LLCE System
		Tank 241-AW-104	
005	12	Transfer Pump	LLCE System
006	4	Thermocouple Tree	LLCE System
007	42	42" Shield Plug	Burial Box
008	42	42" Shield Plug	Burial Box
012	42	Slurry Distributor	Burial Box

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	EQUIPMENT REMOVAL METHOD
022	4	Liquid Observation Well	LLCE System
		Tank 241-AY-101	
1A	34	Transfer Pump	LLCE System
1C	34	Transfer Pump	LLCE System
6A	42	Slurry Distributor	Burial Box
13A	4	Profile Thermocouple Probe	LLCE System
13B	4	Profile Thermocouple Probe	LLCE System
13C	4	Profile Thermocouple Probe	LLCE System
13D	4	Profile Thermocouple Probe	LLCE System
16A	4	Sludge Thermocouple	LLCE System
16B	4	Sludge Thermocouple	LLCE System
16C	4	Sludge Thermocouple	LLCE System
22A	16	Level Indication (ENRAF)	Relocate to Riser 5A
		Tank 241-AY-102	
1A	34	Mixer Pump	LLCE System
1C	34	Transfer Pump	LLCE System
5A	4	Multi-Function Instrument Tree	LLCE System
6A	42	Slurry Distributor	Burial Box
13A	4	Profile Thermocouple Probe	LLCE System
13B	4	Profile Thermocouple Probe	LLCE System
13C	4	Profile Thermocouple Probe	LLCE System
13D	4	Profile Thermocouple Probe	LLCE System
16A	4	Sludge Thermocouple	LLCE System
16B	4	Sludge Thermocouple	LLCE System
16C	4	Sludge Thermocouple	LLCE System
22A	16	Level Indicator (FIC)	Relocate to Riser 5A
		Tank 241-SY-101	
003	4	Velocity Density Tree	LLCE System
007	42	Transfer Pump and Above Ground Pump Pit	Transfer Pump - LLCE System Pump Pit – Burial Box
008	42	Multi-Port Riser Assembly	Burial Box
013	42	Mixer Pump	LLCE System
014	12	Radar Gauge	Burial Box
015	4	Velocity Density Tree	LLCE System
018	4	Multi-Function Instrument Tree	LLCE System
019	4	Multi-Function Instrument Tree	LLCE System
		Tank 241-SY-102	
001	4	Liquid Observation Well	LLCE System
005	12	Transfer Pump	LLCE System
006	4	Thermocouple Tree	LLCE System
007	42	Anti-Siphoning Slurry Distributor	ASSD - LLCE System Top Hat Assembly – Burial Box
008	42	42" Shield Plug	Burial Box
013	42	Air Lift Circulators/Supernate Drop Leg	LLCE System
023	12	242-S Supernate Feed Pump	LLCE System
		Tank 241-SY-103	
005	12	Transfer Pump	LLCE System
006	4	Thermocouple Tree	LLCE System
007	42	Camera/Instruments	Burial Box
008	42	42" Shield Plug	Burial Box
013	42	Slurry Distributor	Burial Box
018	4	Multi-Function Instrument Tree	LLCE System

Other components of the LLCE system, including the FRA, Platform Assemblies, Adapter Assemblies, receiver bags, etc. vary in design and/or configuration depending on the equipment being removed. Original cost estimates included the replacement of many of these components for each LLCE item. To evaluate the possibility of using some of these components for multiple equipment removal operations it was necessary to determine the specific components required for each LLCE being removed.

All of the instrumentation being removed by this project is installed in 4-in. risers therefore the same FRA, Washer Assembly, and Split Spool (when needed) designs can be used in 241-AW, 241-AY, and 241-SY. The LOWs are installed in 6-in. risers therefore the same FRA design can be used but a different Washer Assembly will be required. The receiver bag length varies depending on the specific equipment being removed.

The pump pits in 241-AW and 241-SY are of the same size and configuration therefore the same FRA and Platform Assembly design can be used in both farms. The sluice pits in 241-AY are of a different size and configuration and therefore will require a different Platform Assembly than used in 241-AW and 241-SY. There are variations in the pump designs and in-pit interferences between the different tanks, therefore various Adapter Assemblies, and receiver bags will be required. Appendix A provides a list of the unique LLCE system components associated with each piece of equipment identified for removal.

The following equipment removals in 241-SY-101 and 241-SY-102 will require special consideration due to the unique nature of the equipment:

- The hydrogen mitigation mixer pump is installed in 241-SY-101, Riser 13. Manual disassembly of non-contaminated portions of the pump (external support structure, motor, rotator assembly, etc.) and removal of the support equipment contained in the central pump pit will be required prior to using the LLCE system.

- A new generation transfer pump is installed in an above ground pump pit located in 241-SY-101, Riser 7. New LLCE system components will need to be designed to allow the LLCE system to interface with this unique pit. After the pump is removed, the above ground pit and associated support structure will also need to be removed and disposed of using manual methods.

- An Anti-Siphoning Slurry Distributor (ASSD) is installed in a containment enclosure in 241-SY-102, Riser 7. The containment structure also serves as an adapter between the 42-in. riser and the waste intrusive ASSD. New LLCE system components will need to be designed to allow the LLCE system to interface with this unique riser configuration. After the ASSD is removed, the containment structure will need to be removed and disposed of using manual methods.

The LLCE system has the capacity to remove these components, although new adapters and equipment will need to be designed to allow the system to interface with these unique configurations.

4.2.5 LLCE System Component Evaluation

The components that are of concern from a cost perspective are the ones that were initially identified, and estimated, as "consumable," either because it was felt that they would become excessively contaminated or because they may be unique to a specific equipment pull. These components include the FRA, Adapter Assembly, Platform Assembly, and Washer Assembly (Figures 4-4 and 4-5).

It should be possible to use the same FRA for multiple equipment pulls throughout tank farms as is routinely done with other internally contaminated equipment (i.e. Core Sampling Trucks, casks, portable exhausters, etc).

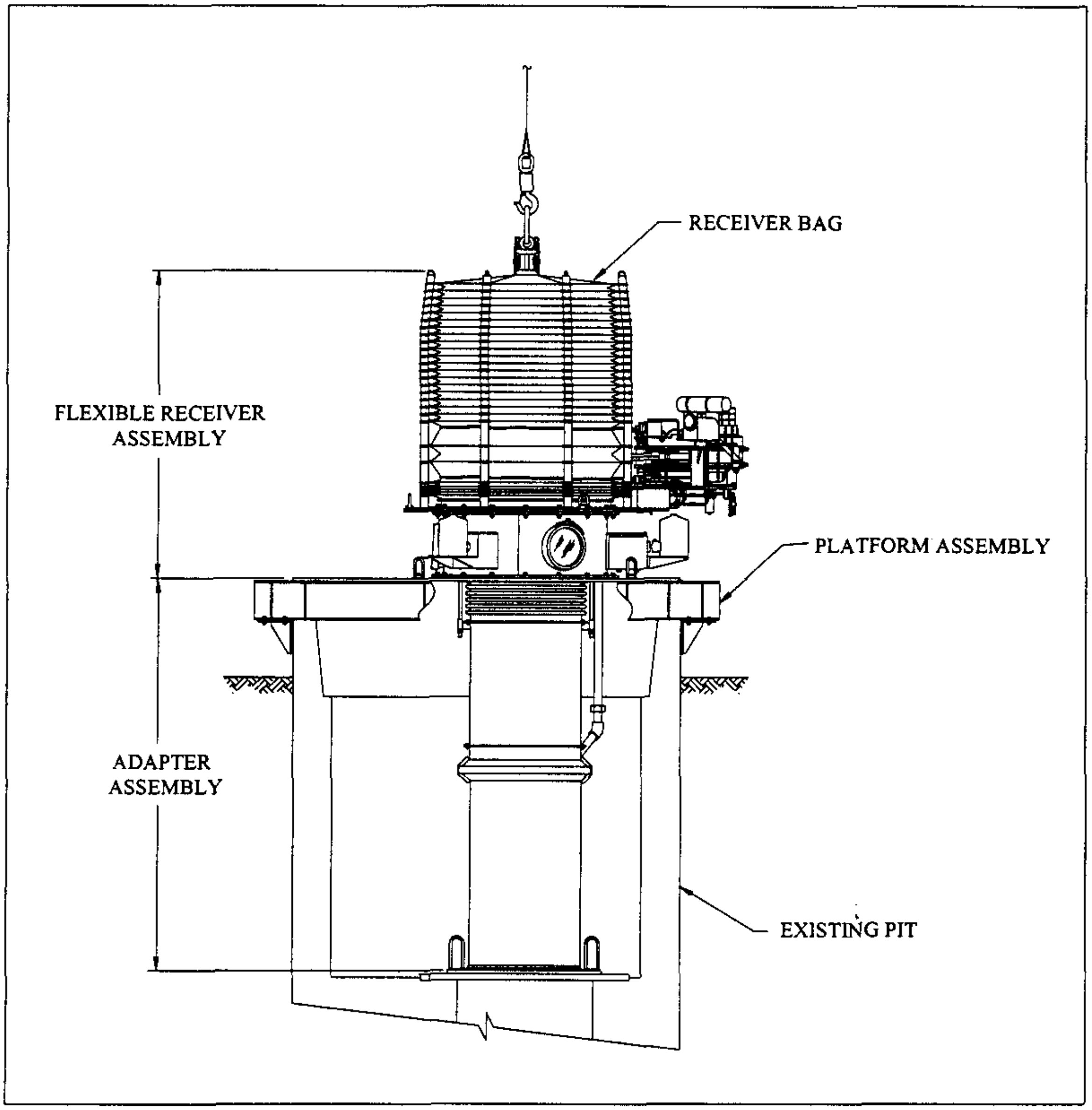

Figure 4-4. 42-In. LLCE System for Equipment in Pit.

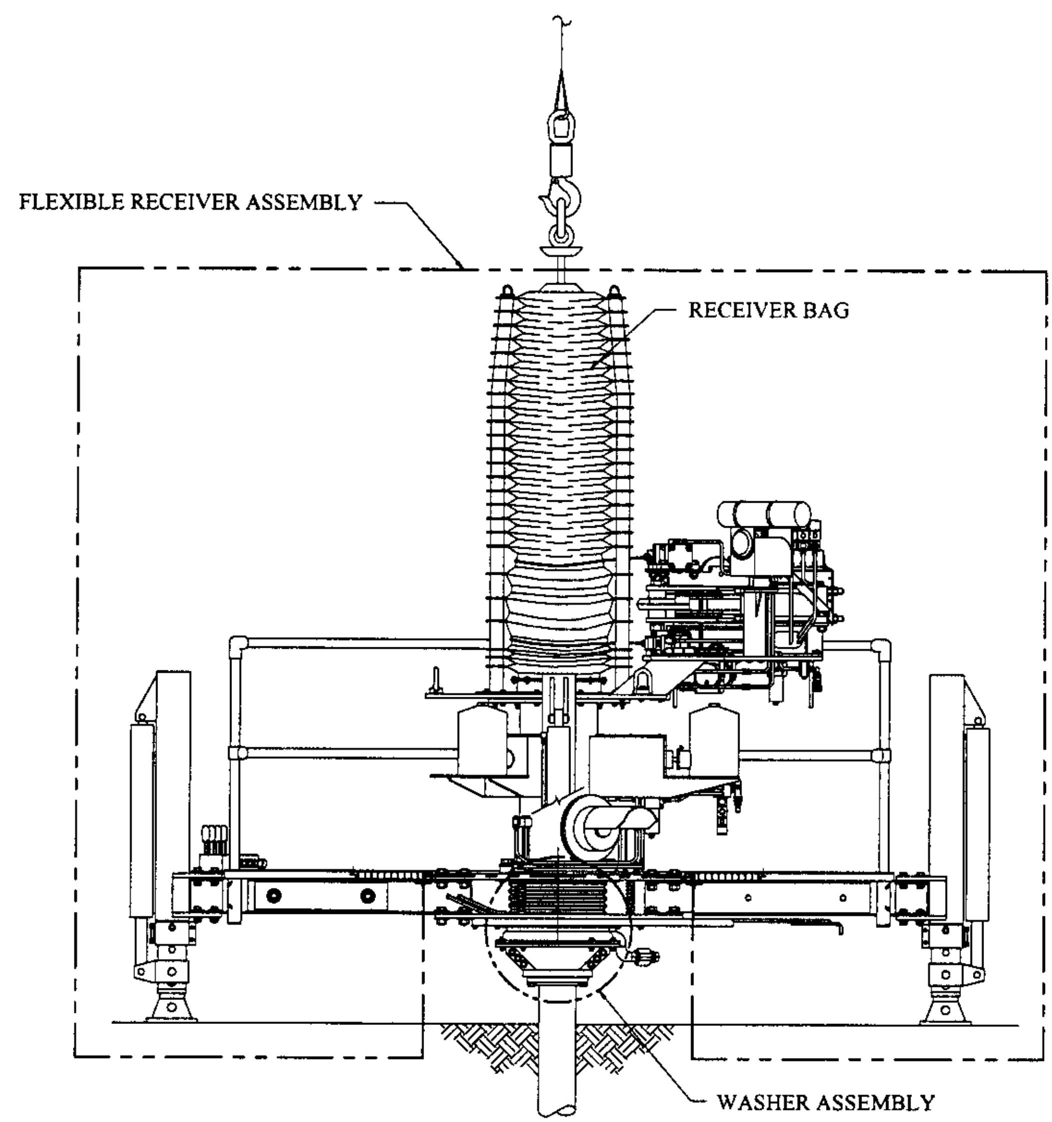

Figure 4-5. 4/6-In. LLCE System for Equipment in Riser.

The Receiver Bag, Burial Container Equipment Skid, and Disposal Container are also considered consumable but since these items are disposed with the waste equipment, and their costs are relatively minor, further evaluation for cost reduction was not performed.

4.2.5.1 Flexible Receiver Assembly

The FRA provides a means of remotely retrieving equipment from a riser into a flexible receiver bag, and remotely sealing the bottom end. The FRA also performs a gamma assay along the length of the equipment as it is being removed. Two sizes of FRAs have been designed. One 4/6-in. assembly is for use on small risers containing such equipment as thermocouple trees and instrumentation trees. This assembly is equipped with load bearing, adjustable legs that ensure FRA loads are not transmitted to the tank riser. The 42-in. assembly is designed for use on larger risers contained in pits that hold such equipment as transfer and mixer pumps. The 42-in. FRA requires the use of a Platform Assembly to interface properly with the pump pit.

The FRA is designed to be reusable. This is accomplished by minimizing the surface area exposed to the contaminated equipment, the use of highly polished, primarily stainless steel, surfaces to facilitate decontamination, and modular construction to facilitate maintenance. In addition, contamination levels on equipment being removed are minimized by the use of a high-pressure spray hot water wash prior to the equipment entering the FRA. It should be possible to use the same FRA for multiple equipment pulls throughout tank farms as is routinely done with other internally contaminated equipment (i.e. Core Sampling Trucks, casks, portable exhausters, etc). Contamination within the FRA could be reduced, if necessary, by the use of easily strippable coatings or disposable plastic liners.

A combination of instrumentation and transfer pumps will be removed from each tank in the scope of this project, therefore both a 4/6-in. and a 42-in. FRA will need to be used on each tank. It was originally estimated that two FRAs, one of each size, would be required for each tank requiring equipment removal, therefore a total of sixteen FRAs would need to be built and disposed. Based on the contamination control features previously mentioned, it should be possible to control contamination within the FRA to a level that would permit transporting the FRA between farms. However, due to the projected duration of this project (18 years), it is doubtful that one set of FRAs could be maintained in good operating condition throughout the entire project. Therefore, it is conservatively estimated that one 4/6-in. and one 42-in. per farm will be required per FRA. This reduces the total number of FRAs required for project W-521 to three 4/6-in. assemblies and three 42-in. assemblies.

4.2.5.2 Adapter Assembly

The Adapter Assembly is used only on 42-in. FRAs (See Figure 4-4), in conjunction with the Platform Assembly, and provides containment between the pit riser and the FRA. A bellows assembly, inflatable bottom seal, and various spool lengths allow the adapter to fit tightly between the Platform Assembly and the pit floor. The assembly also contains a high pressure spray wash ring to minimize external contamination on the equipment being removed.

The Adapter Assembly is application specific due to variations in pump design and interferences within the pit. The same Adapter Assembly design used for removing the transfer pumps in 241-AW could be used to remove two of the pumps in 241-SY. The 241-SY-101 mixer pump and the 242-S feed pump, located in 241-SY-102, require the use of different adapters. The small footprint and increased depth of the 241-AY sluice pit necessitate the need for an Adapter Assembly that is integrated directly into the Platform Assembly. Thus, a minimum of four separate types of Adapter Assemblies will be required by the Project.

It was originally assumed that one Adapter Assembly would be needed for each pit identified for equipment removal. Although the Adapter Assembly could potentially be reused, the cost to decontaminate this assembly to an adequate level to allow multiple uses may exceed the cost of this item. This is due to the fact that equipment being pulled from a riser first enters this portion of the FRA and is washed in this area. In addition, existing equipment in the pits may cause interferences that require modifications for each pit. Because of this, the original assumption of one Adapter Assembly per pit has been determined to be correct. The total number of Adapter Assemblies required for W-521 is thirteen.

4.2.5.3 Platform Assembly

The purpose of the Platform Assembly on the 42" FRA (see Figure 4-4) is to provide a temporary cover for the pit and to provide an interface between the pit, the Adapter Assembly, and the FRA. The Platform Assembly is equipped with restraint brackets that allow the platform to be precisely positioned and secured in the proper location on the pit. The restraint brackets also allow the Platform Assembly to accommodate slight variations in pit size.

The central pump pits in 241-AW and 241-SY are of the same size and configuration therefore the same Platform Assembly design can be used for both of these farms. An above ground pump pit was added to 241-SY-101, Riser 7, which will require a unique Platform Assembly design. In 241-AY, the in-pit equipment being removed using the LLCE System, is installed in sluice pits. All of the sluice pits in 241-AY are the same size but are of a different size and configuration than the central pump pits in 241-AW and 241-SY, therefore a minimum of three different Platform Assembly designs are required by the project. The designs for two of these Platform Assemblies have already been completed and the applicable drawings are listed in Appendix A.

It was originally estimated that one Platform Assembly would be required for each tank; therefore it would be necessary to build and dispose of eight Platform Assemblies. The Platform Assembly is not expected to become significantly contaminated during use because it does not directly contact the contaminated equipment being removed and is protected from washdown spray by the Adapter Assembly. Based on the low chance of the Platform Assembly becoming significantly contaminated and the small variations in pit sizes within each farm, only one Platform Assembly per farm is required for 241-AW and 241-AY. Due to the above ground pump pit in 241-SY, two Platform Assemblies will be required in this farm. This reduces the total number of Platform Assemblies required for project W-521 to four.

4.2.5.4 Washer Assembly

The Washer Assembly is used in conjunction with the 4/6-in. FRA (see Figure 4-5) and provides a containment path between the riser and the FRA. A bellows assembly prevents the FRA from transmitting loads to the tank riser. The assembly contains a spray wash ring to minimize external contamination on the equipment being removed. Designs currently exist for a 4-in. and 6-in. Washer Assembly.

The Washer Assembly is designed to be reusable. The internal surfaces are highly polished surfaces to facilitate decontamination. It should be possible to use the same Washer Assembly for multiple equipment pulls throughout tank farms as is routinely done with other internally contaminated equipment (i.e., Core Sampling riser adapters, foot clamps, casks, etc).

The instrumentation and LOWs that will be removed from 241-AW, 241-AY, and 241-SY are all installed in 4-in. risers, therefore only the 4-in. Washer Assembly will be needed for these farms. The Anti-siphon Slurry Distributor (ASSD), located in 241-SY-102, will require the use of a 6-in Washer Assembly.

It was originally estimated that one Washer Assembly would be required for each above ground riser requiring equipment removal, therefore a total of thirteen assemblies were determined to be fabricated and disposed. Based on the design of this assembly, it should be possible to control contamination within the Washer Assembly to a level that would permit transporting the assembly between farms. But as in the case of the FRA, it is doubtful that one Washer Assembly could be maintained in good operating condition throughout the entire project. Therefore, it is conservatively estimated that one 4-in. assembly will be required for 241-AW and 241-AY. One 4-in. and two 6-in. assemblies, which includes one spare 6-in. assembly, will be required for 241-SY. This reduces the total number of Washer Assemblies required for project W-521 to three 4-in. assemblies and two 6-in. assemblies.

4.2.6 LLCE System Component Inventory

The modified Grove crane and Receiver/Transport Trailer system, have already been procured and will be shared by the W-211 and W-521 projects. The W-521 project will provide a control trailer, assay equipment, and water pump trailer as well as all of the associated support equipment (water hoses, lift yokes, control cables, etc). The W-521 project will need to account for the costs associated with maintaining and refurbishing of the shared equipment as well as spare parts, maintenance and refurbishment of the FRAs, control trailer, and pump equipment throughout the project duration.

Table 4-2 provides a comprehensive inventory of the primary, LLCE system components that need to be supplied by W-521 project. Although some of these components are already built, it is unlikely that they will be available and in operable condition when needed by the W-521 project.

Table 4-2. Required Inventory of Consumable LLCE System Components

LLCE Component	Quantity Required
Control Trailer	1
Assay Equipment Set	1
Water Pump Trailer	1
4/6-in. FRA	3
42-in. FRA	3
Adapter Assembly	13
Platform Assembly	4
4-in. Washer Assembly	3
6-in. Washer Assembly	2
4/6-in. Flexible Receiver Bag	30
42-in. Flexible Receiver Bag	13
26-in. Diameter Burial Container	30
54-in. Diameter Burial Container	12
67-in. Diameter Burial Container	1

5.0 CONCLUSION

The W-521 CDR Outline Specification, in conjunction with the results of the mixer pump impingement study and further refinement of the in-tank equipment needs, was used as a basis for developing a comprehensive equipment removal list. It has been determined that a total of 62 items will require removal by the W-521 project, this number is increased from 49 items in the original CDR estimate.

The LLCE System and manual removal are the primary methods of removing in-tank contaminated equipment at Tank Farms. For removal of non-waste intrusive equipment (i.e., cameras, slurry distributors, shield plugs) within the scope of the W-521 project, the risk to personnel is relatively low therefore using the manual removal method was deemed appropriate. Waste-intrusive equipment such as instrument trees and pumps will be removed via the LLCE System due to the greater associated risk with removing this type of equipment. This evaluation has determined that 43 items will be retrieved with the LLCE System and 19 will be retrieved using manual methods.

The primary LLCE System components required for each piece of equipment identified for removal were evaluated to determine if improvements could be made that would reduce the project costs associated with LLCE removal. From this evaluation it was determined that the pits and risers associated with the LLCE within the scope of the W-521 project are of similar configuration, therefore additional flexibility is not required in the LLCE System design. In addition the current equipment design incorporates features that facilitate decontamination. Based on the configuration of the pits/risers and the equipment design, it will be possible to re-use much of the LLCE System components that were originally assumed to be consumable. One Receiver Bag, equipment skid, and Disposal Container are still required for each piece of in-tank equipment identified for removal. Table 5-1 summarizes the difference in the quantity of consumables based on the results of this evaluation.

Table 5-1. Reduction of LLCE Consumable Components

LLCE Component	Original CDR Quantity	Revised ACD Quantity
FRAs	16	6
Adapter Assemblies	11	12
Platform Assemblies	8	4
Washer Assemblies	13	5

The hydrogen mitigation mixer pump, new generation transfer pump, and the ASSD, located in 241-SY-101 and 241-SY-102 will require special consideration and additional project cost due to the unique removal challenges.

5.1 Cost

The cost reduction associated with these additions is shown in Table 5-2.

Table 5-2. Cost

LLCE REMOVAL - REDUCTION FROM CDR												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$4,181,366	-$321,680	-$1,501,632	-$150,924	-$509,724	-$420,114	-$86,569	-$553,383	-$524,507	-$1,264,973	-$2,478,759	-$3,386,477	-$15,380,108

6.0 REFERENCES

ARES 1998, *Long-Length Contaminated Equipment Disposal Process Path Document*, HNF-SD-WM-ER-730, Revision 1, ARES Corporation, Richland, Washington

HND 2000a, *Mixer Pump Impingement Force On In-Tank Equipment For Project W-521, Waste Feed Delivery Systems*, Report No. 990920203-015, Revision 0, ARES Corporation, Richland, Washington

HND 2000b, *Mixer Pump Analysis To Support Procurement Specification Preparation For Project W-521, Waste Feed Delivery Systems*, Report No. 990920203-018, Revision 0, ARES Corporation, Richland, Washington

Appendix A
W-521 In-Tank Equipment Removal Matrix

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
241-AW-101								
005	12	Transfer Pump	Temperature Tree Installation	H-14-010502 H-2-70420	H-2-70312 H-2-824750	LLCE System	3	Platform Assembly (H-2-824709-010) Adapter Assembly (H-2-824818-070) Receiver Bag (H-2-79143-060) Burial Container (54-in. Diameter)
006	4	Thermocouple Tree	Obsolete	H-14-010502 H-2-824751	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
007	42	42" Shield Plug	Mixer Pump Installation	H-14-010502	N/A	Burial Box	N/A	N/A
008	42	Camera/ Instruments	Mixer Pump Installation	H-14-010502	N/A	Burial Box	N/A	N/A
012	42	Slurry Distributor	Transfer Pump	H-14-010502	H-2-70312	Burial Box	N/A	N/A
017	4	Multi-Function Instrument Tree	Obsolete	H-14-010502	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-150) Burial Container (26-in. Diameter)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
241-AW-103								
005	12	Transfer Pump	Temperature Tree Installation	H-14-010502	H-2-70312 H-2-824754	LLCE System	3	Platform Assembly (H-2-824709-010) Adapter Assembly (H-2-824818-070) Receiver Bag (H-2-79143-030) Burial Container (54-in. Diameter)
006	4	Thermocouple Tree	Obsolete	H-14-010502	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
007	42	42" Shield Plug	Mixer Pump Installation	H-14-010502	N/A	Burial Box	N/A	N/A
008	42	42" Shield Plug	Mixer Pump Installation	H-14-010502	N/A	Burial Box	N/A	N/A
012	42	Slurry Distributor	Transfer Pump Installation	H-14-010502	H-2-70312	Burial Box	N/A	N/A
014	4	Liquid Observation Well	Impingement Forces. Fiberglass material – condition indeterminate.	H-14-010502	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
241-AW-104								
005	12	Transfer Pump	Temperature Tree Installation	H-14-010502	H-2-70312 H-2-824755	LLCE System	3	Platform Assembly (H-2-824709-010) Adapter Assembly (H-2-824818-070) Receiver Bag (H-2-79143-060) Burial Container (54-in. Diameter)
006	4	Thermocouple Tree	Obsolete	H-14-010502	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
007	42	42" Shield Plug	Mixer Pump Installation	H-14-010502	N/A	Burial Box	N/A	N/A
008	42	42" Shield Plug	Mixer Pump Installation	H-14-010502	N/A	Burial Box	N/A	N/A
012	42	Slurry Distributor	Transfer Pump Installation	H-14-010502	H-2-70312	Burial Box	N/A	N/A
022	4	Liquid Observation Well	Obsolete	H-14-010502	N/A	LLCE System		Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
241-AY-101								
1A	34"	Transfer Pump	Mixer Pump Installation	H-14-010506	H-2-824758	LLCE System	3	Platform Assembly (H-2-824712-010) Adapter Assembly (Included w/ platform) Receiver Bag (H-2-79143-070) Burial Container (54-in. Diameter)
1C	34"	Transfer Pump	Mixer Pump Installation	H-14-010506	H-2-824758	LLCE System	3	Platform Assembly (H-2-824712-010) Adapter Assembly (Included w/ platform) Receiver Bag (H-2-79143-070) Burial Container (54-in. Diameter)
6A	42"	Slurry Distributor	Transfer Pump Installation	H-14-010506	H-2-H-2-64421	Burial Box	N/A	N/A
13A	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
13B	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
13C	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
13D	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
16A	4	Sludge Temperature	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
16B	4	Sludge Temperature	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
16C	4	Sludge Temperature	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
								Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
241-AY-102								
1A	34"	Mixer Pump	Mixer Pump Installation	H-14-010506	H-2-64423	LLCE System	3	Platform Assembly (H-2-824712-010) Adapter Assembly (Included w/ platform) Receiver Bag (H-2-79143-070) Burial Container (54-in. Diameter)
1C	34"	Transfer Pump	Mixer Pump Installation	H-14-010506	H-2-824759	LLCE System	3	Platform Assembly (H-2-824712-010) Adapter Assembly (Included w/ platform) Receiver Bag (H-2-79143-070) Burial Container (54-in. Diameter)
5A	4	Multi-Function Instrument Tree	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-150) Burial Container (26-in. Diameter)
6A	42"	Slurry Distributor	Transfer Pump Installation	H-14-010506	H-2-64421	Burial Box	N/A	N/A
13A	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
								(H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
13B	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
13C	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
13D	4	Profile Thermocouple Probe	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
16A	4	Sludge Temperature	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
								(26-in. Diameter)
16B	4	Sludge Temperature	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
16C	4	Sludge Temperature	Obsolete	H-14-010506	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
241-SY-101								
003	4	Velocity Density Tree	Impingement Force	H-14-010531 H-2-815016	N/A	LLCE	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-150) Burial Container (26-in. Diameter)
007	42	Transfer Pump and Above Ground Pump Pit	Mixer Pump Installation	H-14-010531	H-14-103570	Transfer Pump - LLCE System / Pump Pit – Burial Box	3	Platform Assembly (Not Designed) Adapter Assembly (Not Designed) Receiver Bag (H-2-79143-030) Burial Container (54-in. Diameter)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
008	42	Multi-Port Riser Assembly	Mixer Pump Installation	H-14-010531	N/A	Burial Box	N/A	N/A
013	42	Mixer Pump	Transfer Pump Installation	H-14-010531	H-2-815006	Unique and difficult application. Pump - LLCE System Support Equipment – Burial Box	3	Platform Assembly (Not Designed) Adapter Assembly (Not Designed) Receiver Bag (Unknown) Burial Container (67-in. Diameter)
014	12	Radar Gauge	Camera Installation	H-14-010531	N/A	Burial Box	N/A	N/A
015	4	Velocity Density Tree	Impingement Force	H-14-010531 H-2-815016	N/A	LLCE	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-150) Burial Container (26-in. Diameter)
018	4	Multi-Function Instrument Tree	Impingement Force	H-14-010531 H-2-85123	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-150) Burial Container (26-in. Diameter)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
019	4	Multi-Function Instrument Tree	Impingement Force	H-14-010531 H-2-85123	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-150) Burial Container (26-in. Diameter)
241-SY-102								
001	4	Liquid Observation Well	Impingement Force. Fiberglass material – condition indeterminate.	H-14-010531 H-2-93715	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
005	12	Transfer Pump	Temperature Tree Installation	H-14-010531	H-2-824776	LLCE System	3	Platform Assembly (H-2-824709-010) Adapter Assembly (H-2-824818-070) Receiver Bag (H-2-79143-030) Burial Container (54-in. Diameter)
006	4	Thermocouple Tree	Obsolete	H-14-010531 H-2-824778	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-140) Burial Container (26-in. Diameter)
007	42	Anti-Siphoning	Mixer Pump	H-14-010531	N/A	ASSD -	3	Platform Assembly

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
		Slurry Distributor (ASSD)	Installation	H-14-103590		LLCE System / Tophat Assembly – Burial Box		(Not Designed) Adapter Assembly (Not Designed) Receiver Bag (H-2-79143-030) Burial Container (26-in. Diameter)
008	42	42" Shield Plug	Mixer Pump Installation	H-14-010531	N/A	Burial Box	N/A	N/A
013	42	Air Lift Circulators/ Supernate Drop Legs	Transfer Pump Installation	H-14-010531	H-2-37782 H-2-46202	LLCE System	3	Platform Assembly (Not Designed) Adapter Assembly (Not Designed) Receiver Bag (H-2-79143-060) Burial Container (54-in. Diameter)
023	12	242-S Supernate Transfer Pump	Impingement Force	H-14-010531	H-2-824775	LLCE System	3	Platform Assembly (H-2-824706-010) Adapter Assembly (H-2-824818-110) Receiver Bag (H-2-79143-060) Burial Container (54-in. Diameter)

RISER	SIZE (IN.)	EXISTING EQUIPMENT TO BE REMOVED	REASON FOR REMOVAL	APPLICABLE RISER DRAWINGS	APPLICABLE PIT DRAWINGS	EQUIPMENT REMOVAL METHOD	LLCE SYSTEM COMPONENTS	
							ARRANGEMENT TYPE (Per H-2-79190)	UNIQUE COMPONENTS/ DRAWING
241-SY-103								
005	12	Transfer Pump	Temperature Tree Installation	H-14-010531	H-2-824779	LLCE System	3	Platform Assembly (H-2-824709-010) Adapter Assembly (H-2-824818-070) Receiver Bag (H-2-79143-060) Burial Container (54-in. Diameter)
006	4	Thermocouple Tree	Obsolete	H-14-010531 H-2-824780	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-160) Burial Container (26-in. Diameter)
007	42	Camera/Instrument	Mixer Pump Installation	H-14-010531	N/A	Burial Box	N/A	N/A
008	42	42" Shield Plug	Mixer Pump Installation	H-14-010531	N/A	Burial Box	N/A	N/A
013	42	Slurry Distributor	Transfer Pump Installation	H-14-010531	H-2-37782 H-2-46202	Burial Box	N/A	N/A
018	4	Multi-Function Instrument Tree	Impingement Force	H-14-010531 H-2-85123	N/A	LLCE System	2	Split Spool Assembly (H-2-824798-010) 4" Washer Assembly (H-2-79337-2) Receiver Bag (H-2-79143-150) Burial Container (26-in. Diameter)

Attachment M

Attachment M

Double-Shell Tank Monitor and Control Subsystem Improvement

DOUBLE-SHELL TANK MONITOR AND CONTROL SUBSYSTEM IMPROVEMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Release 46
Report No. 990920203-021
ACDR Subtask 13
Revision 0

September 2000

prepared by

HND TEAM

DOUBLE-SHELL TANK MONITOR AND CONTROL SUBSYSTEM IMPROVEMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Release 46
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Prepared by: Mike Garcia, P.E.

Approved by: RLFritz
Robert L. Fritz

Date: 9-29-00

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Tables

Acronyms

CMS	Central Monitoring System
DST	Double-Shell Tank
HMI	Human-Machine Interfaces
ISA	International Society for Measurement and Control
MPS	Master Pump Shutdown
PLC	Programmable Logic Controllers
RCS	Retrieval Control System
RPP	River Protection Project
SDD	System Design Description
TFLAN	Tank Farm Local Area Network
TMACS	Tank Monitoring and Control Systems
VPI	Valve Position Indication
WFD	Waste Feed Delivery
WTF	Waste Treatment Facility

1.0 INTRODUCTION

Project W-521, Waste Feed Delivery (WFD) Systems, provides an integral part of the retrieval and transport systems needed to deliver the waste to the Waste Treatment Facility (WTF). A variety of project and expense-funded activities supply other portions of the retrieval and transport systems. The River Protection Project (RPP) requires that several projects work together to achieve a common goal.

Project W-314 is currently designing a general service Tank Farm Local Area Network (TFLAN), that will be used as a backbone control system communications network for the new Master Pump Shutdown (MPS) system and other RPP monitor and control systems including the W-521 Retrieval Control System (RCS).

1.1 Purpose

The purpose of this task is to improve the W-521 RCS design and identify any issues that may affect technical capabilities and/or cost specifically related to the integration of the RCS with other monitor and control systems.

1.2 Scope

From the "*Advanced Conceptual Design Work Plan*":

This task involves reviewing existing requirements for interfacing with the TFLAN, refining these requirements and applying these refinements to the W-521 RCS design.

Activities to be performed as part of this task:

- Review *Double-Shell Tank Monitor and Control Subsystem Specification*, HNF 4155, REV. 1, (DRAFT),
- Review international society for measurement and control (ISA) standards for applicability to the W-521 RCS design, and
- Refine Double-Shell Tank (DST) Monitor and Control TFLAN interface requirements.

One additional activity that will be completed as part of this task is to revise the RCS System Design Description (SDD) based on the requirements listed in HNF 4155, REV. 1, (DRAFT). Upon the initial review of the HNF 4155, REV. 1, (DRAFT), it was apparent that the RCS SDD should be revised to capture new requirements. Also, it should be noted that the SDD completed during conceptual design primarily utilized other draft level 2 specifications and draft process control strategies for design requirements. A new revision of HNF 4155, REV. 1, (DRAFT) was reviewed and will be released around the end of this fiscal year. Project W-521 will work closely with the author of HNF 4155, REV. 1, (DRAFT) to ensure timely completion of the W-521 RCS SDD.

2.0 METHODOLOGY

A review of the latest draft of HNF 4155, REV. 1, (DRAFT), *Double-Shell Tank Monitor and Control Subsystem Specification* was performed in order to determine any new requirements for instrumentation, monitoring and control.

A new revision of HNF-4155, Rev. 1, (DRAFT), was being circulated for final approval during the completion of the advanced conceptual design phase. It was decided during the advanced conceptual phase that the HNF-4155, Rev.1(DRAFT) contained the necessary refinement and additional detail to more effectively support the advanced conceptual design effort.

Interviews were also conducted and input obtained from tank farm subject matter experts pertaining to the scope of new projects and existing hardware configuration.

3.0 ASSUMPTIONS

A Central Monitoring System (CMS) will be designed and installed prior to the W-521 RCS becoming operational. The CMS will design and implement an interface between TFLAN and Tank Monitoring and Control Systems (TMACS), allowing systems that are connected to TFLAN the capability to read TMACS data. The current draft version of RPP Functions and Requirements for Tank Farms Monitoring and Control Systems will be revised to primarily focus on the requirements of the CMS. If the TFLAN/TMACS interface is not completed then W-521 will connect signals to RCS as required.

TMACS is a safety significant system.

The TFLAN will be a general service system. Project W-314 is currently designing the TFLAN as general service.

4.0 DISCUSSION

The RPP monitor and control systems encompasses all of the Tank Farms and supporting systems including current monitor and control systems and future systems. The DST Monitor and Control Subsystem consists of new and existing equipment that will be used to provided tank farm operators with an integrated local monitoring and control of the DST systems to support WFD.

4.1 Summary of HNF 4155, REV. 1, (DRAFT) TFLAN Interface Requirements

Reference Advanced Conceptual Design Report, *Existing Instrumentation Interface Refinement for Project W-521, Waste Feed Delivery Systems*. This document discusses the TMACS parameters that will be received by the RCS via TFLAN.

a. <u>**Requirement:**</u> The DST Monitor and Control Subsystem shall receive tank waste temperature data. DST Monitor and Control System shall receive DST Tank Waste Temperature from

TMACS, at a selectable poling rate, via TFLAN for those temperature probes that are monitored by TMACS.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF 4155, REV. 1, (DRAFT), Rev 1, Section 3.2.1.2.2.*

b. **Requirement**: The DST Monitor and Control Subsystem shall receive the following DST ventilation system data from TMACS via TFLAN for those ventilation parameters monitored by TMACS:

- Tank vapor space pressure (-6 to +4 inches of water)
- Annulus exhaust stack beta (CAM) continuous air monitor alarm status
- Primary exhaust stack beta CAM alarm status
- Standard hydrogen monitor system hydrogen concentration and alarm status
- Primary exhauster run status
- Annulus exhauster run status
- HEPA filter differential pressure

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF 4155, REV. 1, (DRAFT), Rev 1, Section 3.2.1.5.1.*

c. **Requirement**: Centralize remote surveillance monitoring. The W-521 RCS shall have the capability to interface with the TFLAN. Conceptual level data block transfers are defined in the W-521 Advanced conceptual Design Report design.

Basis: *Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 2.0.*

d. **Requirement**: The DST Monitor and Control Subsystem shall receive DST annulus primary leak data from TMACS via TFLAN for those tanks whose annuli are monitored by TMACS.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF 4155, REV. 1, (DRAFT), Rev 1, Section 3.2.1.4.2.*

4.2 Tank Farm Local Area Network

The W-314 MPS is a sub-system of the DST Monitor and Control System. The scope of W-314 is to replace the existing MPS system with the new programmable logic controllers (PLC) based system. The W-314 MPS Project plans to install the TFLAN. The intent of the design is to provide a backbone LAN for the new MPS system and future control systems. The general service fiber optic Ethernet network will connect PLCs and Human-Machine Interfaces (HMIs) together. The TFLAN design will also include servers and additional network hardware and software to make the network operational.

TFLAN will be utilized by existing as well as new RPP monitor and control systems.

4.2.1 Central Monitoring Station / TFLAN Interface

The Central Monitoring Station is a centralized supervisory monitoring system that will provide an HMI for viewing Tank Farm processes, including waste transfers. The CMS shall have access to all important data including data that will be generated by current and future projects.

Also, as part of the CMS project an interface will be established between TMACS and TFLAN. Both W-521 and W-211 plan on obtaining TMACS data from TFLAN. At this time the TFLAN design is not complete. It is anticipated that the TFLAN design will be completed at the end of this fiscal year.

Some of the data monitored by TMACS is important to WFD operations, and is Safety Significant (SS), such as:

- Tank Waste Levels
- Tank Waste Temperatures

4.2.2 W-521 RCS/TFLAN Interface

For 241-SY, 241-AW, and 241-AY, the TFLAN fiber will be extended from existing nodes to the new ICE buildings utilizing the existing infrastructure. The network will be configured to integrate the W-521 RCS. It is important in the planning stages to ensure that the capability for expansion of hardware and software is built into the system from the initial concept. This is especially important given the project schedules and the level of integration required to make the WFD system operational.

A preliminary design for the W-314 MPS TFLAN design was reviewed, and resulting refinement to Project W-521 advanced conceptual design is as follows:

4.2.2.1.AW Scope

TFLAN

A fiber optic cabinet that includes a Fiber Distribution Panel (FDP), Media Converter, hub, and power strip, will be located in the new ICE building. TFLAN will be extended from the 2506E2 building to the existing 241-AW-271 instrument building.

Electrical

The electrical estimate completed during the conceptual design phase provided for adequate raceways to route fiber optic cable from the existing instrument building to the new ICE building. The electrical raceway was initially accounted for in the conceptual design estimate.

4.2.2.2.SY Scope

TFLAN

A fiber optic cabinet that includes a Fiber Distribution Panel (FDP), Media Converter, hub, and power strip, will be located in the new ICE building. TFLAN will be extended from a location near the 252S substation or 242S Evaporator to the new SY ICE building.

Electrical

Project W-521 trenching and planned conduit routings will be utilized to route the data cable from HH-099 near the 252S substation to the new SY ICE building. The initial estimate completed during the conceptual design phase is adequate to cover the electrical scope of work.

4.2.2.3.AY Scope

TFLAN

A fiber optic cabinet that includes a Fiber Distribution Panel (FDP), Media Converter, hub, and power strip, will be located in the new ICE building. TFLAN will be extended from the 2506E2 building to pole E439, to the existing instrument building, and finally to the new AY ICE building.

Electrical

Project W-521 trenching and planned conduit routings will be utilized to route the data cable from E439 to the new AY ICE building. The initial estimate completed during the conceptual design phase is adequate to cover the electrical scope of work.

4.2.2.4. Valve Position Indication

During the conceptual design phase of Project W-521 Valve Position Indication (VPI) was general service, and the RCS was general service. General service inputs including VPI switches at the pump pits and transfer pits were wired to the W-521 RCS.

Project W-314 design provides general service PLC Inputs and Outputs (I/O) to receive W-521 valve position switches from the existing AP and the new AP-A valve pits. These are the only W-521 valve position switches that are wired to the W-314 system. All other valve position data will be sent to the W-314 MPS via TFLAN.

TFLAN is planned to be used to pass VPI data along with other process parameters between monitor and control systems connected to TFLAN. An assumption on the part of Project W-314 is that all valve positions will be independently and visually verified in the field allowing VPI I/O to be general service.

If the PLC that receives VPI switches is required to be safety significant, there will need to be adjustments to the design as well as appropriate adjustments to cost. Other projects providing RPP monitor and control systems would also be affected.

4.2.3 W-521/W-211 TFLAN Interfaces

The AW diluent system will be designed and installed at AW and will supply diluent to the AW and AP tank farms, and the WTF transfer lines. The Diluent system is general service. Diluent system data necessary for WFD will be transferred between the W-521 RCS and the W-211 RCS. The AN diluent system will be designed and installed by Project W-211 and will supply diluent to the AN, AZ, and AY tank farm. Again, TFLAN will provide an interface the systems provided by W-521 and W-211.

4.3 Standardization of Equipment and Components

In general, the standardization of systems and components will facilitate the interface and integration between monitor and control systems provided by various projects including W-314, W-521, W-523, and W-211. Systems installed by W-314 will need to be modified each time new systems are installed that interface with the W-314 MCS. It is important to allow flexibility in the methods and methodology as related to interfacing these systems including a standard process for configuration management.

The W-314 MPS PLC manufacturer, RTP Corporation, does have a software quality assurance program that meets the requirements of NQA-1. Additionally, the PLC manufacturer routinely supplies PLCs and software for their PLCs to Nuclear Power Plants.

It is anticipated that RTP will also be used for the W-521 RCS, and that other WFD projects will also use RTP. W-211 is currently evaluating the use of RTP.

From conversations with W-314 project personnel and the RTP vendor, the cost of an general service RTP system is comparable to other well known industrial PLC manufacturers.

Project W-521, W-314, and W-211 plan on using Citech HMI software.

4.4 WTF Interface

As reflected in Project W-521 conceptual design drawings and documentation, W-521 provided conductors for safety significant permissive signals, and communications media for a data link.

At this time, Project W-314 does not have an interface with the WTF.

Project W-314 is providing PLC I/O for valve limit switches and leak detectors associated with the AP and AP-A valve pit. Per conversations with Project W-314 control system lead, the few hardwired permissive signals between the WTF and Tank Farms can be accommodated using spare MPS rack space located in 241-AP-271 building. The data link may be more appropriately implemented by the CMS project.

Project W-521 does not have a PLC or control system equipment at 241-AP. It was assumed during the conceptual design phase of Project W-521 that W-314 Phase II would provide all necessary programming.

4.5 Standards Reviewed

4.5.1 ISA Standards, Recommended Practices and Technical Reports Review

All of the ISA standards were reviewed for applicability to the design of W-521 RCS. There were not any standards identified that would impact the current cost estimate. Applicable ISA standards will be utilized during definitive design.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Long Range Plan For The Integration of RPP Monitor and Control Systems

A long-range plan is required that specifically defines the roles and responsibilities for each project that provides a piece of the RPP monitor and control system.

As noted previously, the monitor and control systems are made up of existing as well as new systems. The duration and schedules of the projects that make up the monitor and control systems encompass several years. The plan should cover system architecture, design philosophy, safety classification, operational requirements, maintenance requirements, network administration, configuration management, and change control.

5.2 Standardization of Components and Equipment Including Software

It is recommended that monitor and control system hardware and software be standardized. This will maximize the ability to more simply implement integration and consolidation of system functions for WFD.

5.3 Safety Significant Issue

- TMACS is a safety significant system. The RCS and TFLAN is general service. The safety significant functions should remain with TMACS.

- One possible solution is to upgrade the existing design by providing a backup communications link for safety significant signals or upgrading the existing TFLAN design to safety significant. This would allow changes in the safety classifications of parameters to take place without significantly impacting the basic design and communications architecture.

- If the RCS PLC is required to be Safety Significant, changes will be required that will affect cost.

5.4 TFLAN

Utilize the existing TFLAN infrastructure and extend TFLAN to new W-521 ICE Buildings.

5.5 Cost

The cost to accomplish these recommendations are shown in Table 5-1.

Table 5-1. Cost

DST MONITOR & CONTROL SUB SYSTEM – ADDITIONAL COST												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
$120,000	$0	$43,200	$8,160	$40,800	$13,464	$2,774	$19,584	$16,320	$39,643	$63,464	$73,518	$440,927

6.0 REFERENCES

HNF 4155, REV. 1, (DRAFT), Rev. 0, *DST Monitor & Control Subsystem Specification*, CH2M Hill Hanford Group, Richland, Washington.

Draft, *River Protection Project Functions and Requirements for Monitoring and Control Systems*, CH2M Hill Hanford Group, Richland, Washington.

RPP-5831, Rev. 0, *Failure and Reliability Analysis for the Master Pump Shutdown System*, Fluor Federal Services, Inc., August 2000.

Attachment N

Attachment N

Existing Instrumentation Interface Refinement

EXISTING INSTRUMENTATION INTERFACE REFINEMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

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Contract 4412, Release 46
Report No. *990920203-010*
ACDR Subtask 14
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September *2000*

prepared by

HND TEAM

EXISTING INSTRUMENTATION INTERFACE REFINEMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

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Prepared by: Danny Mendoza

Approved by: R L Fritz
Robert L. Fritz

Date: 9-30-00

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Appendices

Tables

Acronyms

CAM	Continuous Air Monitor
CASS	Computer Automated Surveillance System
DST	Double Shell Tank
HEPA	High Efficiency Particulate Air
I/O	Input/Output
MCS	Monitor and Control Subsystem
P&ID	Piping & Instrument Diagrams
PLC	Programmable Logic Controller
RCS	Retrieval Control Subsystem
RTD	Resistance Temperature Detector
SHMS	Standard Hydrogen Monitoring System
T/C	Thermocouple
TFLAN	Tank Farms Local Area Network
TMACS	Tank Monitoring and Control System
WFD	Waste Feed Delivery Systems

1.0 INTRODUCTION

The Double Shell Tank (DST) Monitor and Control Subsystem (MCS) consists of new and existing equipment that will be used to provide tank farms operators with integrated local monitoring and control of the DST system to support Waste Feed Delivery Systems (WFD). The W-521 Retrieval Control System (RCS) is a subsystem of the DST MCS and will monitor required tank and waste transfer parameters during WFD for selected tanks in the AW, AY and SY Farms.

The W-521 RCS will interface with the Tank Monitor and Control System (TMACS) via the Tank Farms Local Area Network (TFLAN). W-521 RCS will also interface directly with existing tank farm instrumentation where required.

2.0 PURPOSE

The purpose of this evaluation is to further define the interface requirements with existing instrumentation, and to determine the basic hardware and architecture required to implement the interfaces. The results of this evaluation will be used to further refine the cost estimate.

3.0 SCOPE

The scope of this task is to review the requirements for interfaces with existing double shell tank instrumentation to provide further definition to these requirements, and apply these findings to the W-521 design and cost estimate. These interfaces will occur with existing instrumentation located at the AW-101, AW-103, AW-104, AY-101, AY-102, SY-101, SY-102, and SY-103 tanks and associated instrument buildings.

4.0 METHODOLOGY

A review of the latest HNF-4155, Double-Shell Tank Monitor and Control Subsystem Specification, was performed in order to determine any new requirements for instrumentation and monitoring and control. It should be noted that Revision 0 of the Level 2 Specification is the current approved version. A redline/strikeout copy of the above mentioned document was obtained and reviewed which provided more detailed information with respect changes to the monitoring and control requirements.

Additionally, a review was performed on a number of Hanford Site drawings, particularly Piping & Instrumentation Diagrams (P&ID), in order to determine interface points between existing instrumentation and the W-521 Retrieval Control System (RCS) which will be used to monitor tank parameters during WFD.

Interviews were also conducted and input obtained from tank farm subject matter experts pertaining to existing hardware configuration. Subject matter experts provided qualitative insight to the reliability of some existing monitoring systems.

5.0 ASSUMPTIONS

Several key assumptions were made in order to further develop the interface requirements for the W-521 RCS. The assumptions include the following:

- The majority of the proposed changes reviewed in the latest draft of Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, will be approved and issued.

- For tanks AW-101, -103, -104, SY-101, -102, and –103, one temperature probe assembly installed in close proximity to the center of the tank with 18 temperature monitoring points (RTDs on temperature probe assembly spaced 2 feet apart with top 2 RTDs spaced 4 feet apart) is adequate for waste temperature monitoring. A new temperature probe will be installed which is designed to withstand mixer pump impingement forces, and will replace the existing 18-point temperature probe assembly in each tank. In AY-101 and AY-102, five temperature trees will be installed in each tank. These new probes, along with refractory concrete (bottom of tank) and concrete structure thermocouples will be adequate to provide necessary temperature data.

- TMACS will continue its monitoring function and will continue to have the capability to monitor selected tank parameters when the W-521 RCS becomes operational.

- The TMACS / TFLAN interface will be implemented by others and will be available for W-521 RCS interface.

- CASS is de-activated. Work is in progress to connect parameters previously monitored by CASS. These parameters will eventually be available to W-521 RCS via TFLAN. A listing of these parameters is provided in Appendix B.

- For the purposes of this task, tanks currently identified as requiring SHMS, will also require SHMS during WFD activities. No new in-tank gas analysis (SHMS) equipment is to be installed.

6.0 DISCUSSION

6.1 Tank Structure Temperature Monitoring – General Description

The above referenced draft Level 2 Specification states that the MCS shall monitor the bottom insulating concrete temperatures and other selected structure temperatures as measured by existing temperature elements. Tank bottom insulating concrete thermocouple signals shall be received at the DST MCS I/O and this data used to determine effective sludge mobilization of tank wastes. Additionally, concrete structure thermocouple signals shall be received, as required, by the DST MCS. In general, the following paragraphs describe the existing configuration for concrete structure and refractory concrete temperature monitors.

6.1.1 AW Tank Farm

All concrete structure and refractory concrete thermocouple signals are sent to the 241-AW-271 instrument building and are available to be read locally via a handheld device.

The AW Farm concrete structure and refractory concrete thermocouple signals monitored by TMACS are connected to Westronics multiplexers located in the 241-AW-271 building. When polled by TMACS, a modem also located in the instrument building, sends data to TMACS via telephone wire. TMACS polling rates are selectable at once per second, once per ten seconds, once per minute, once per ten minutes, or once per hour.

6.1.2 AY Tank Farm

Temperature signals from the thermocouples located in the refractory concrete between the primary and secondary tanks and from concrete structure for AY-101 and AY-102 are connected to multiplexers located in the 241-AY-801A instrument building.

6.1.3 SY Tank Farm

All concrete structure and refractory concrete thermocouple signals for the SY tanks are sent to the 241-SY-271 instrument building. These signals are available to be read locally at the instrument building via a handheld device.

The SY Farm concrete structure thermocouples monitored by TMACS are connected to Acromag multiplexers. The Acromag multiplexers are located adjacent to the tank temperature trees. Temperature data is sent from the multiplexer to a modem located in the 241-SY-271 instrument building. When polled by TMACS, the modem sends the data.

In addition, selected SY-101 tank refractory concrete thermocouples are connected to a multiplexer located in the 241-SY-271 instrument building, and the data is sent ultimately to the DACS trailer.

Refractory concrete thermocouples for tanks SY-102 and SY-103 are not presently monitored by TMACS.

No physical interface is required between W-521 RCS and the thermocouples that are currently being monitored by TMACS. The W-521 RCS will obtain these temperatures from TMACS via TFLAN.

6.2 Refractory Concrete Temperatures

The refractory concrete structure is located directly below the primary carbon steel tank and provides the bottom support for the primary tank. Table 6-1 summarizes the W-521 required interface with the refractory concrete thermocouples.

Table 6-1. W-521 Existing Refractory Concrete Thermocouple Interface

TANK	EXISTING CONFIGURATION	DOCUMENT REF.	W-521 INTERFACE REQUIRED
AW-101	3 refractory concrete T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020602-1	Install multiplexer, connect remaining 21 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
AW-103	3 refractory concrete T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020602-3	Install multiplexer, connect remaining 21 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
AW-104	3 refractory concrete T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020602-4	Install multiplexer, connect remaining 21 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
AY-101	25 T/Cs to multiplexer in 241-AY-801A Inst. Bldg	H-14-020606-1	Datalink or wiring between existing multiplexers and W-521 RCS
AY-102	25 T/Cs to multiplexer in 241-AY-801A Inst. Bldg	H-14-020606-2	Datalink or wiring between existing multiplexers and W-521 RCS
SY-101	Refractory concrete T/Cs monitored by DACS	WHC-SD-WM-TI-594 H-14-020631-1	Connect remaining T/C signals not monitored by DACS multiplexer (approximately 12)
SY-102	Refractory concrete T/C signals to 241-SY-271 Bldg	WHC-SD-WM-TI-594 H-14-020631-2	Install multiplexer, connect 24 T/C signals to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
SY-103	Refractory concrete T/C signals to 241-SY-271 Bldg	WHC-SD-WM-TI-594 H-14-020631-3	Install multiplexer, connect 24 T/C signals to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.

6.2.1 AW Tank Farm

There are a total of 24 thermocouples located in the refractory concrete for each of the AW tanks within the scope of Project W-521. Of these 24 thermocouples, only 3 thermocouple signals from each tank are monitored by TMACS. This leaves an additional 21 thermocouples per tank available for monitoring. Thermocouple extension wire is routed to the 241-AW-271 instrument building for each these thermocouples.

A multiplexer will be installed to connect the thermocouples. The multiplexer will be data linked to the W-521 RCS.

6.2.2 AY Tank Farm

Temperature signals from the 25 thermocouples located in the refractory concrete between the primary and secondary tanks for AY-101 and AY-102 are connected to multiplexers that are located in the 241-AY-801A instrument building.

Data links will be installed between the existing multiplexers and the W-521 RCS.

6.2.3 SY Tank Farm

There are a total of 24 thermocouples located in the refractory concrete for each of the SY tanks within W-521 scope. However, none of the refractory concrete thermocouples for the SY-Tanks are monitored by TMACS. The SY-101 refractory concrete thermocouples are monitored at the DACS trailer and these temperature signals are sent to a multiplexer located in the 241-SY-271 instrument building, which is datalinked to the DACS.

Where required, Project W-521 will provide new multiplexers to connect existing refractory concrete thermocouples. Project W-521 will install data links between multiplexers (existing and new) and the W-521 RCS.

6.3 Concrete Structure Temperatures

Table 6-2 summarizes the W-521 required interfaces with the concrete structure thermocouples. The latest draft of the Level 2 spec does not clearly define the number of thermocouples required to be interfaced with the RCS. Further analysis is required to determine the number of thermocouples that are required to be monitored by the W-521 RCS.

Table 6-2. W-521 Existing Concrete Structure Thermocouple Interface

TANK	EXISTING CONFIGURATION	DOCUMENT REF.	W-521 INTERFACE REQUIRED
AW-101	6 concrete structure T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020502-1	Install multiplexer, connect remaining 51 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
AW-103	6 concrete structure T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020502-3	Install multiplexer, connect remaining 51 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
AW-104	6 concrete structure T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020502-4	Install multiplexer, connect remaining 51 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
AY-101	All T/Cs monitored by TMACS	H-14-020506-1	Datalink connection to TFLAN and software programming and network configuration
AY-102	All T/Cs monitored by TMACS	H-14-020606-2	Datalink connection to TFLAN and software programming and network configuration
SY-101	6 concrete structure T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020531-1	Install multiplexer, connect remaining 51 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
SY-102	6 concrete structure T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020531-2	Install multiplexer, connect remaining 51 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.
SY-103	6 concrete structure T/Cs monitored by TMACS	WHC-SD-WM-TI-594 H-14-020531-3	Install multiplexer, connect remaining 51 T/Cs to multiplexer, with output to W-521 RCS. Trenching, conduit/wire installation required.

6.3.1 AY Tank Farm

AY-101 and AY-102 thermocouples located in the concrete structure are currently connected to a data acquisition multiplexer located in the 241-AY-801A instrument building, which is data linked to TMACS.

W-521 RCS will interface with this existing equipment through software programming and network configuration in order to obtain temperature data off the TFLAN.

6.3.2 AW Tank Farm

TMACS currently monitors six concrete structure temperatures (dome and wall structure) for each of the AW tanks (AW-101, AW-103, and AW-104). All other concrete structure thermocouple signals are routed to the 241-AW-271 instrument building where temperatures can be read via a handheld device. A selector switch is used to select the thermocouple of interest for temperature readout.

Where required, Project W-521 will provide new multiplexers to connect existing concrete structure thermocouples. Project W-521 will install data links between multiplexers (existing and new) and the W-521 RCS. Programming and network configuration will be required to read data from TMACS via TFLAN.

6.3.3 SY Tank Farm

TMACS currently monitors 6 concrete structure temperature signals from the thermocouples located in the concrete structure each of the SY tanks for (SY-101, SY-102, and SY-103). All other concrete thermocouple signals are routed to the 241-SY-271 instrument building where temperatures can be read via a handheld device. A selector switch is used to select the thermocouple of interest for temperature readout.

Where required, Project W-521 will provide new multiplexers to connect existing concrete structure thermocouples. Project W-521 will install data links between multiplexers (existing and new) and the W-521 RCS. Programming and network configuration will be required to read data from TMACS via TFLAN.

6.4 Tank Waste Temperature Monitoring

Waste temperature monitoring is required to determine if operating temperatures are exceeded and to control WFD process operations.

Under the current hardware configuration, all temperature data from temperature probes in the AW-101 (one temperature tree and one MIT), AW-103 (one temperature tree), AW-104 (one temperature tree), SY-101 (two MITs), SY-102 (one temperature tree), and SY-103 (one temperature tree) are monitored by TMACS. The AY-101 and AY-102 waste temperature is not monitored by TMACS.

New temperature tree assemblies will replace tank waste temperature trees. This replacement is a result of:

- Existing thermocouple trees and MITs, within the scope of this project, will not withstand mixer pump impingement forces (HND 990920203-015, 2000),
- Existing thermocouples, although functional, cannot be maintained, calibrated, or replaced,
- Certain types of thermocouples on existing trees are susceptible to corrosion and subsequent failure (J Types), and
- Existing thermocouple trees have an estimated age of over 20 years and expected life has not been determined.

6.4.1 AW Tank Farm

The existing temperature probes will be removed. Local indication will be preserved to meet existing tank farm operational requirements.

One new safety significant temperature probe will be installed in AW-101, AW-103, and AW-104, as was planned in the CDR.

6.4.2 AY Tank Farm

The existing Profile Thermocouple Trees (PTCs) in AY-101 and AY-102 will be removed. These PTCs have 3 thermocouples that monitor temperatures one at the bottom of the tree, one at the middle and one at the top. Local indication will be preserved to meet existing tank farm operational requirements, as was planned in the CDR.

Five new safety significant temperature probes will be installed in each of the AY-Tanks in both (AY-101 and AY-102) as was planned in the CDR.

6.4.3 SY Tank Farm

The existing temperature probes will be removed. Local indication will be preserved to meet existing tank farm operational requirements.

Pressure measurement and gas monitoring capability will be maintained to meet existing requirements. This includes pressure measurement at SY-101 riser 018 and 019, and at SY-103 riser 018. Gas monitoring capability will be maintained at SY-101 018.

One new safety significant temperature probe will be installed in SY-101, SY-102, and SY-103, as was planned in the CDR.

6.5 Tank Level Monitoring

All tanks within the W-521 scope have ENRAF level gauges installed (AW-101, AW-103, AW-104, AY-101, AY-102, SY-101, SY-102, and SY-103). All ENRAF level signals for the above tanks are monitored by TMACS. The W-521 RCS will interface with this existing equipment to obtain waste tank levels data from TMACS via TFLAN. No further hardware interfaces are required for these tanks.

Tanks levels for AW-101, AW-103, and AW-104, are shown going to the Computer Automated Surveillance System (CASS) on the latest H-14 Series drawings, but in fact, are currently connected and being monitored by TMACS.

Table 6-3 summarizes the W-521 required interfaces with the existing waste level measuring system.

Table 6-3. Existing Waste Level Measuring System Interface

TANK	EXISTING CONFIGURATION	DOCUMENT REF.	W-521 INTERFACE REQUIRED
AW-101	Waste level signal goes to TMACS	WHC-SD-WM-TI-594	Programming and network configuration required
AW-103	Waste level signal goes to TMACS	WHC-SD-WM-TI-594	Programming and network configuration required
AW-104	Waste level signal goes to TMACS	WHC-SD-WM-TI-594	Programming and network configuration required
AY-101	Waste level signal to TMACS	H-14-020606-1	Programming and network configuration required
AY-102	Waste level signal to TMACS	H-14-020606-2	Programming and network configuration required
SY-101	Waste level signal to TMACS	H-14-020631-1	Programming and network configuration required
SY-102	Waste level signal to TMACS	H-14-020631-2	Programming and network configuration required
SY-103	Waste level signal to TMACS	H-14-020631-3	Programming and network configuration required

6.6 In-Tank Gas Analysis

AW-103, AW-104, and AY-101 are not equipped with SHMS cabinets, and per the identified assumption will not require upgrades, although per the Level 2 specification, in-tank gas sampling is required during WFD activities.

Per the Level 2 specification, in-tank gas sampling is required during WFD activities. Monitoring is done via Standard Hydrogen Monitoring Cabinets (SHMS).

Additionally, there are SHMS cabinets on the common exhaust header for SY farm and AW farm, which monitors hydrogen levels in the exhaust stream before expelling into the atmosphere.

6.6.1 AW Tank Farm

SHMS data for AW-101 is available from TMACS. W-521 RCS will interface with existing equipment through software programming and network configuration. Project W-521 will not install any new SHMS cabinets for AW-103 or AW-104.

6.6.2 AY Tank Farm

The AY-102 SHMS is not monitored by TMACS. Conduit and wiring will be required to be installed between the SHMS cabinet and the W-521 ICE building in order to monitor AY-102 hydrogen concentrations at the W-521 RCS. Project W-521 will not install any new SHMS cabinets for AY-101.

6.6.3 SY Tank Farm

SHMS data for SY-101, SY-102, and SY-103 are available from TMACS. W-521 RCS will interface with existing equipment through software programming and network configuration.

Table 6-4. Existing In-Tank Gas Analysis System Interface

TANK	EXISTING CONFIGURATION	DOCUMENT REF.	W-521 INTERFACE REQUIRED
AW-101	In-tank gas analysis information to TMACS	WHC-SD-WM-TI-594 H-14-020102-1 H-14-024002-1	Programming and network configuration
AW-103	No SHMS on individual tank	N/A	N/A
AW-104	No SHMS on individual tank	N/A	N/A
AY-101	No SHMS on individual tank	N/A	N/A
AY-102	SHMS has local PLC	WHC-SD-WM-TI-594 H-14-024006-1	Trenching, conduit/wire installation required between SHMS cabinet and W-521 ICE Building
SY-101	In-tank gas analysis information to TMACS	WHC-SD-WM-TI-594 H-14-020531-1 H-14-024031-1	Programming and network configuration
SY-102	In-tank gas analysis information to TMACS	WHC-SD-WM-TI-594 H-14-024031-5	Programming and network configuration
SY-103	In-tank gas analysis information to TMACS	WHC-SD-WM-TI-594 H-14-020531-1 H-14-024031-4	Programming and network configuration

6.7 Ventilation Parameters:

The Level 2 Specification requires certain ventilation parameters to be monitored by the MCS in support of WFD activities. These parameters include the following:

- Tank Vapor Pressure,
- Annulus exhaust stack beta Continuous Air Monitor (CAM) alarm status,
- Primary exhaust beta CAM alarm status,
- SHMS status and alarm,
- Annulus exhauster run status,
- Primary exhauster run status, and
- HEPA differential pressure.

Per discussion with W-314 project personnel, PLCs will be used to control the new ventilation systems for AW and SY Farms and flexibility for monitoring parameters will be provided.

The SHMS status and alarm interface is discussed in Section "In-Tank Gas Analysis".

As was noted in the identified assumptions, TMACS will be monitoring those signals previously monitored by CASS. Some of these signals include annulus ventilation low flow and annulus CAM high radiation as shown Appendix B.

Clarification is needed for the beta CAM status requirement and exhauster run status. It is uncertain at this time if the beta CAM status includes notification of CAM failure, low vacuum pump flow, along with high radiation. TMACS will monitor the annulus high radiation alarm, which will be available via the TFLAN. Exhauster run status can be determined by tank vapor pressure being negative or by exhaust flow. Exhaust low flow will be monitored by TMACS and will be available via TFLAN.

6.7.1 AW Tank Farm

Project W-314 will upgrade the primary ventilation system at AW. Primary ventilation parameters will be available over TFLAN.

AW annulus ventilation parameters will be hardwired to the W-521 RCS if not available from TMACS via TFLAN.

6.7.2 AY Tank Farm

Project W-521 will upgrade portions of the primary AY/AZ ventilation system. Some ventilation parameters such as primary exhaust CAM status will be available to the W-521 RCS via TFLAN as these parameters are currently monitored by TMACS. Other parameters such as primary exhaust run status and HEPA filter differential pressure can be obtained via data-link between 241-AZ-271 and the Project W-521 ICE Building or via hardwire between the 241-AZ-702 Vent building and the Project W-521 ICE Building.

Project W-521 will upgrade the annulus ventilation system. Ventilation parameters will be available to the W-521 RCS via TFLAN.

6.7.3 SY Tank Farm

Project W-314 will upgrade the primary ventilation system at SY. Primary ventilation parameters will be available over TFLAN.

SY annulus ventilation parameters will be hardwired to the W-521 RCS if not available from TMACS via TFLAN.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The specific items recommended to be upgraded/modified are identified below, while the costs to include these items are shown in Appendix C.

7.1 Tank Structure Temperature

Tank structure temperature signals can be obtained from existing thermocouples. Only 3 refractory concrete thermocouples and 6 concrete thermocouples per tank are currently monitored by TMACS. Although no specific number of thermocouples are called out in the Level 2 Specification, concrete structure and refractory concrete temperatures will be required to be monitored to determine effective mixing of waste. Installation of multiplexer(s), connection of remaining thermocouples to the multiplexer(s), and trenching and conduit/wire installation are required in order for W-521 to receive temperature signals at the RCS. Tables 6-1 and 6-2 provide the summary of interfacing required between existing instrumentation and W-521 RCS. Programming and network configuration will be required to interface with the TFLAN to obtain temperature data monitored by TMACS.

7.2 Tank Waste Temperature

W-521 will install new, robust, highly accurate temperature trees in each of the tanks to replace existing temperature tree(s). Therefore, no interface with existing instrumentation is required to obtain tank waste temperature data for W-521 RCS.

The reliability of some of the existing thermocouples used to measure temperature is in question based on failures seen to date. Although no reliability study exists that documents these failures, failure rates, or expected life of these thermocouples, subject matter experts agreed that the Type J thermocouple (Iron/Constantan) has experienced failure due to corrosion of the iron leads. Once the iron leads break, an open circuit exists and temperatures can no longer be read from this thermocouple. Thermocouple trees in SY-102 and SY-103 have J Type thermocouples. Existing temperature probes within the scope of this project will not withstand mixer pump forces, and all existing temperature probes will be removed.

7.3 Tank Waste Level

All waste level data will be available from the TFLAN. Programming and network configuration will be required to interface with the TFLAN to obtain the level data monitored by TMACS.

7.4 SHMS Cabinets

All tanks currently equipped with SHMS cabinets are monitored by TMACS with the exception of AY-102. AY-102 will require conduit and wiring to be installed between the SHMS cabinet and the W-521 ICE building in order to monitor AY-102 hydrogen concentrations on the W-521 RCS. Programming and network configuration will be required to interface with the TFLAN to obtain SHMS data monitored by TMACS. Project W-521 scope does not include installation of SHMS in those tanks currently not equipped with SHMS.

7.5 Tank Ventilation

Primary tank exhaust ventilation upgrades for AW and SY farms and the parameters required to be monitored will be provided by W-314. W-521 will be upgrading the AY/AZ primary tank exhaust ventilation system. Primary exhauster run status and HEPA filter differential pressure can be obtained via data-link from the 241-AZ-271 building and signals will be sent to the Project W-521 ICE Building to the RCS. Signals can also be obtained at the ICE Building via hardwire to the 241-AZ-702 Vent building.

Some signals, such as exhaust low flow and CAM high radiation will be picked up by TMACS and will be available on the TFLAN. Further refinement of the proposed level 2 spec requirement is necessary to understand specifically what parameters require monitoring.

7.6 Cost

The cost to accomplish these additions is shown in Table 7-1.

Table 7-1. Cost

EXISTING INSTRUMENTATION INTERFACE - ADD TO CDR ESTIMATE												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
$171,830	$37,299	$71,918	$14,052	$70,262	$23,186	$4,778	$33,726	$14,052	$71,375	$103,664	$123,863	$740,005

8.0 REFERENCES

HND-990920203-015, Mixer Pump Impingement Force on In-Tank Equipment for Project W-521, Waste Feed Delivery Systems.

HNF-4155, Rev. 0, Double-Shell Tank Monitor and Control Subsystem Specification.

WHC-SD-WM-TI-594, Rev. 3 (Draft), TMACS I-O Termination Point Listing.

HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis Volume III, Waste Feed Delivery System Description.

RPP-5366, Rev.1, Functions, Requirements, and Specifications for replacement of the Computer Automated Surveillance System (CASS).

9.0 INTERVIEWS

- Robert R. Bevins, CHG, Infrastructure Upgrades (W-314)
- Dave J. Born, Numatec Hanford Company, Projects
- Katie A. White, CHG, Waste Feed Delivery Systems
- Mike Hay, CHG, West Area Maintenance Supervisor, Instrument Control & Electrical
- Chuck Scaief, CHG, Equipment Engineering
- Doug Larsen, CHG, S Complex Operations

Appendix A
Thermocouple Signals Monitored by TMACS

The following table is a listing of temperature, level, and in-tank gas analysis signals monitored by TMACS. This data was obtained from WHC-SD-WM-TI-594, Rev. 3 (Draft), TMACS I-O Termination Point Listing for Tank Farms AW, AY, and SY.

Thermocouple Signals Monitored by TMACS

					REF DRAWINGS		
TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	H-2	H-14-	FIELD TAG (20 CHAR)
AW101-TI-WST-R017-001	TC, AW101, RISER 017, TE001, HT 004 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-1
AW101-TI-WST-R017-002	TC, AW101, RISER 017, TE002, HT 016 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-2
AW101-TI-WST-R017-003	TC, AW101, RISER 017, TE003, HT 028 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-3
AW101-TI-WST-R017-004	TC, AW101, RISER 017, TE004, HT 052 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-4
AW101-TI-WST-R017-005	TC, AW101, RISER 017, TE005, HT 076 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-5
AW101-TI-WST-R017-006	TC, AW101, RISER 017, TE006, HT 100 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-6
AW101-TI-WST-R017-007	TC, AW101, RISER 017, TE007, HT 112 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-7
AW101-TI-WST-R017-008	TC, AW101, RISER 017, TE008, HT 124 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-8
AW101-TI-WST-R017-009	TC, AW101, RISER 017, TE009, HT 148 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-9
AW101-TI-WST-R017-010	TC, AW101, RISER 017, TE010, HT 172 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-10
AW101-TI-WST-R017-011	TC, AW101, RISER 017, TE011, HT 196 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-11
AW101-TI-WST-R017-012	TC, AW101, RISER 017, TE012, HT 208 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-12
AW101-TI-WST-R017-013	TC, AW101, RISER 017, TE013, HT 220 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-13
AW101-TI-WST-R017-014	TC, AW101, RISER 017, TE014, HT 232 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-14
AW101-TI-WST-R017-015	TC, AW101, RISER 017, TE015, HT 244 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-15
AW101-TI-WST-R017-016	TC, AW101, RISER 017, TE016, HT 292 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-16
AW101-TI-UA-RJA	AW101, UNIT A, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
AW101-TI-UA-RJB	AW101, UNIT A, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
AW101-TI-WST-R017-017	TC, AW101, RISER 017, TE017, HT 316 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-17
AW101-TI-WST-R017-018	TC, AW101, RISER 017, TE018, HT 340 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-18
AW101-TI-WST-R017-019	TC, AW101, RISER 017, TE019, HT 364 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-19
AW101-TI-WST-R017-020	TC, AW101, RISER 017, TE020, HT 392 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-20
AW101-TI-WST-R017-021	TC, AW101, RISER 017, TE021, HT 402 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-21
AW101-TI-WST-R017-022	TC, AW101, RISER 017, TE022, HT 427 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-22
AW101-TI-UB-RJA	AW101, UNIT B, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
AW101-TI-UB-RJB	AW101, UNIT B, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
AW101-TI-STRU-003	AW101 TE063, FLOOR R07FT 50°	AI:TC TYPE E	-148~1832	deg F	70344		TE-101-03 (WST-63)*
AW101-TI-STRU-010	AW101 TE070, FLOOR R21FT 56°	AI:TC TYPE E	-148~1832	deg F	70344		TE-101-10 (WST-70)*
AW101-TI-STRU-020	AW101 TE080, FLOOR R36FT 46°	AI:TC TYPE E	-148~1832	deg F	70344		TE-101-20 (WST-80)*

					REF DRAWINGS		
TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	H-2	H-14-	FIELD TAG (20 CHAR)
AW101-TI-R006-036	TC, AW101, RISER 006, TE036, HT 004 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-36 (WST)
AW101-TI-R006-037	TC, AW101, RISER 006, TE037, HT 028 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-37 (WST)
AW101-TI-R006-038	TC, AW101, RISER 006, TE038, HT 052 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-38 (WST)
AW101-TI-R006-039	TC, AW101, RISER 006, TE039, HT 076 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-39 (WST)
AW101-TI-R006-040	TC, AW101, RISER 006, TE040, HT 100 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-40 (WST)
AW101-TI-R006-041	TC, AW101, RISER 006, TE041, HT 124 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-41 (WST)
AW101-TI-R006-042	TC, AW101, RISER 006, TE042, HT 148 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-42 (WST)
AW101-TI-R006-043	TC, AW101, RISER 006, TE043, HT 172 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-43 (WST)
AW101-TI-R006-044	TC, AW101, RISER 006, TE044, HT 196 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-44 (WST)
AW101-TI-R006-045	TC, AW101, RISER 006, TE045, HT 220 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-45 (WST)
AW101-TI-R006-046	TC, AW101, RISER 006, TE046, HT 244 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-46 (WST)
AW101-TI-R006-047	TC, AW101, RISER 006, TE047, HT 268 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-47 (WST)
AW101-TI-R006-048	TC, AW101, RISER 006, TE048, HT 292 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-48 (WST)
AW101-TI-R006-049	TC, AW101, RISER 006, TE049, HT 316 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-49 (WST)
AW101-TI-R006-050	TC, AW101, RISER 006, TE050, HT 340 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-50 (WST)
AW101-TI-R006-051	TC, AW101, RISER 006, TE051, HT 364 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-51 (WST)
AW101-TI-R006-052	TC, AW101, RISER 006, TE052, HT 412 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-52 (WST)
AW101-TI-R006-053	TC, AW101, RISER 006, TE053, HT 460 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-101-53 (WST)
AW101-TI-STRU-054	AW101 TE054, DOME CNCR OTSD R38FT 169°	AI:TC TYPE E	-148~1832	deg F	70347		TE-101-54 (WSTA)
AW101-TI-STRU-060	AW101 TE060, DOME CNCR INSD R37FT 169°	AI:TC TYPE E	-148~1832	deg F	70347		TE-101-60 (WSTA)
AW101-TI-STRU-074	AW101 TE074, WALL CNCR OTSD HT01FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-101-74 (WSTA)
AW101-TI-STRU-077	AW101 TE077, WALL CNCR INSD HT01FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-101-77 (WSTA)
AW101-TI-STRU-080	AW101 TE080, WALL CNCR INSD HT29FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-101-80 (WSTA)
AW101-TI-STRU-083	AW101 TE083, WALL CNCR OTSD HT29FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-101-83 (WSTA)
AW103-TI-STRU-003	AW103 TE063, FLOOR R07FT 50°	AI:TC TYPE E	-148~1832	deg F	70344		TE-103-03 (WST-63)*
AW103-TI-STRU-010	AW103 TE070, FLOOR R21FT 56°	AI:TC TYPE E	-148~1832	deg F	70344		TE-103-10 (WST-70)*
AW103-TI-STRU-020	AW103 TE080, FLOOR R36FT 46°	AI:TC TYPE E	-148~1832	deg F	70344		TE-103-20 (WST-80)*
AW103-TI-R006-036	TC, AW103, RISER 006, TE036, HT 004 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-36 (WST)
AW103-TI-R006-037	TC, AW103, RISER 006, TE037, HT 028 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-37 (WST)
AW103-TI-R006-038	TC, AW103, RISER 006, TE038, HT 052 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-38 (WST)
AW103-TI-R006-039	TC, AW103, RISER 006, TE039, HT 076 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-39 (WST)
AW103-TI-R006-040	TC, AW103, RISER 006, TE040, HT 100 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-40 (WST)
AW103-TI-R006-041	TC, AW103, RISER 006, TE041, HT 124 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-41 (WST)
AW103-TI-R006-042	TC, AW103, RISER 006, TE042, HT 148 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-42 (WST)

					REF DRAWINGS		
TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	H-2	H-14-	FIELD TAG (20 CHAR)
AW103-TI-R006-043	TC, AW103, RISER 006, TE043, HT 172 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-43 (WST)
AW103-TI-R006-044	TC, AW103, RISER 006, TE044, HT 196 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-44 (WST)
AW103-TI-R006-045	TC, AW103, RISER 006, TE045, HT 220 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-45 (WST)
AW103-TI-R006-046	TC, AW103, RISER 006, TE046, HT 244 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-46 (WST)
AW103-TI-R006-047	TC, AW103, RISER 006, TE047, HT 268 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-47 (WST)
AW103-TI-R006-048	TC, AW103, RISER 006, TE048, HT 292 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-48 (WST)
AW103-TI-R006-049	TC, AW103, RISER 006, TE049, HT 316 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-49 (WST)
AW103-TI-R006-050	TC, AW103, RISER 006, TE050, HT 340 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-50 (WST)
AW103-TI-R006-051	TC, AW103, RISER 006, TE051, HT 364 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-51 (WST)
AW103-TI-R006-052	TC, AW103, RISER 006, TE052, HT 412 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-52 (WST)
AW103-TI-R006-053	TC, AW103, RISER 006, TE053, HT 460 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-103-53 (WST)
AW103-TI-STRU-054	AW103 TE054, DOME CNCR OTSD R38FT 169°	AI:TC TYPE E	-148~1832	deg F	70347		TE-103-54 (WSTA)
AW103-TI-STRU-060	AW103 TE060, DOME CNCR INSD R37FT 169°	AI:TC TYPE E	-148~1832	deg F	70347		TE-103-60 (WSTA)
AW103-TI-STRU-074	AW103 TE074, WALL CNCR OTSD HT01FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-103-74 (WSTA)
AW103-TI-STRU-077	AW103 TE077, WALL CNCR INSD HT01FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-103-77 (WSTA)
AW103-TI-STRU-080	AW103 TE080, WALL CNCR INSD HT29FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-103-80 (WSTA)
AW103-TI-STRU-083	AW103 TE083, WALL CNCR OTSD HT29FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-103-83 (WSTA)
AW104-TI-STRU-003	AW104 TE063, FLOOR R07FT 50°	AI:TC TYPE E	-148~1832	deg F	70344		TE-104-03 (WST-63)*
AW104-TI-STRU-010	AW104 TE070, FLOOR R21FT 56°	AI:TC TYPE E	-148~1832	deg F	70344		TE-104-10 (WST-70)*
AW104-TI-STRU-020	AW104 TE080, FLOOR R36FT 46°	AI:TC TYPE E	-148~1832	deg F	70344		TE-104-20 (WST-80)*
AW104-TI-R006-036	TC, AW104, RISER 006, TE036, HT 004 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-36 (WST)
AW104-TI-R006-037	TC, AW104, RISER 006, TE037, HT 028 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-37 (WST)
AW104-TI-R006-038	TC, AW104, RISER 006, TE038, HT 052 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-38 (WST)
AW104-TI-R006-039	TC, AW104, RISER 006, TE039, HT 076 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-39 (WST)
AW104-TI-R006-040	TC, AW104, RISER 006, TE040, HT 100 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-40 (WST)
AW104-TI-R006-041	TC, AW104, RISER 006, TE041, HT 124 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-41 (WST)
AW104-TI-R006-042	TC, AW104, RISER 006, TE042, HT 148 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-42 (WST)
AW104-TI-R006-043	TC, AW104, RISER 006, TE043, HT 172 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-43 (WST)
AW104-TI-R006-044	TC, AW104, RISER 006, TE044, HT 196 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-44 (WST)
AW104-TI-R006-045	TC, AW104, RISER 006, TE045, HT 220 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-45 (WST)
AW104-TI-R006-046	TC, AW104, RISER 006, TE046, HT 244 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-46 (WST)
AW104-TI-R006-047	TC, AW104, RISER 006, TE047, HT 268 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-47 (WST)
AW104-TI-R006-048	TC, AW104, RISER 006, TE048, HT 292 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-48 (WST)
AW104-TI-R006-049	TC, AW104, RISER 006, TE049, HT 316 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-49 (WST)

					REF DRAWINGS		
TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	H-2	H-14-	FIELD TAG (20 CHAR)
AW104-TI-R006-050	TC, AW104, RISER 006, TE050, HT 340 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-50 (WST)
AW104-TI-R006-051	TC, AW104, RISER 006, TE051, HT 364 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-51 (WST)
AW104-TI-R006-052	TC, AW104, RISER 006, TE052, HT 412 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-52 (WST)
AW104-TI-R006-053	TC, AW104, RISER 006, TE053, HT 460 IN	AI:TC TYPE E	-148~1832	deg F	34304		TE-104-53 (WST)
AW104-TI-STRU-054	AW104 TE054, DOME CNCR OTSD R38FT 169°	AI:TC TYPE E	-148~1832	deg F	70347		TE-104-54 (WSTA)
AW104-TI-STRU-060	AW104 TE060, DOME CNCR INSD R37FT 169°	AI:TC TYPE E	-148~1832	deg F	70347		TE-104-60 (WSTA)
AW104-TI-STRU-074	AW104 TE074, WALL CNCR OTSD HT01FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-104-74 (WSTA)
AW104-TI-STRU-077	AW104 TE077, WALL CNCR INSD HT01FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-104-77 (WSTA)
AW104-TI-STRU-080	AW104 TE080, WALL CNCR INSD HT29FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-104-80 (WSTA)
AW104-TI-STRU-083	AW104 TE083, WALL CNCR OTSD HT29FT 49°	AI:TC TYPE E	-148~1832	deg F	70347		TE-104-83 (WSTA)
SY101-TI-STRU-112	SY101 TE112, DOME CNCR OTSD R21FT 49°	AI:TC TYPE J	-193~1400	deg F	37754		TE-101-112
SY101-TI-STRU-115	SY101 TE115, DOME CNCR INSD R21FT 49°	AI:TC TYPE J	-193~1400	deg F	37754		TE-101-115
SY101-PDI-R17B-7-1	PT, SY101, TANK ΔP, RISER 17B	AI:4-20 MADC	-5~20	INWG	815456		PE-7-1
SY101-TI-R17B-19	TC, SY101, RISER 17B, TE019 , HT 292 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-19
SY101-TI-R17B-20	TC, SY101, RISER 17B, TE020 , HT 316 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-20
SY101-TI-R17B-21	TC, SY101, RISER 17B, TE021 , HT 340 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-21
SY101-TI-R17B-22	TC, SY101, RISER 17B, TE022 , HT 364 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-22
SY101-TI-R17B-23A	TC, SY101, RISER 17B, TE023A, HT 392 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-23A
SY101-TI-R17B-24	TC, SY101, RISER 17B, TE024 , HT 402 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-24
SY101-TCSH-U1-FAN	RTU CONTROL OF COOLING FAN	DO:115 VAC	ON(1)/OFF(0)	----			NONE
SY101-TI-U1-RJA	SY101, U1, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-U1-RJB	SY101, U1, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-R17B-01	TC, SY101, RISER 17B, TE001 , HT 004 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-1
SY101-TI-R17B-03A	TC, SY101, RISER 17B, TE003A, HT 016 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-3A
SY101-TI-R17B-04	TC, SY101, RISER 17B, TE004 , HT 028 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-4
SY101-TI-R17B-05	TC, SY101, RISER 17B, TE005 , HT 052 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-5
SY101-TI-R17B-06	TC, SY101, RISER 17B, TE006 , HT 076 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-6
SY101-TI-R17B-07A	TC, SY101, RISER 17B, TE007A, HT 100 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-7A
SY101-TI-R17B-08	TC, SY101, RISER 17B, TE008 , HT 112 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-8
SY101-TI-R17B-09A	TC, SY101, RISER 17B, TE009A, HT 124 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-9A
SY101-TI-R17B-10	TC, SY101, RISER 17B, TE010 , HT 148 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-10
SY101-TI-R17B-12	TC, SY101, RISER 17B, TE012 , HT 172 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-12
SY101-TI-R17B-13	TC, SY101, RISER 17B, TE013 , HT 196 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-13
SY101-TI-R17B-14	TC, SY101, RISER 17B, TE014 , HT 208 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-14

TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	REF DRAWINGS H-2	REF DRAWINGS H-14-	FIELD TAG (20 CHAR)
SY101-TI-R17B-15	TC, SY101, RISER 17B, TE015 , HT 220 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-15
SY101-TI-R17B-16	TC, SY101, RISER 17B, TE016 , HT 232 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-16
SY101-TI-R17B-17	TC, SY101, RISER 17B, TE017 , HT 244 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-17
SY101-TI-R17B-18	TC, SY101, RISER 17B, TE018 , HT 268 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17B-18
SY101-TI-U2-RJA	SY101, U2, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-U2-RJB	SY101, U2, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-STRU-092	SY101 TE092, WALL CNCR OTSD HT01FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-101-92
SY101-TI-STRU-095	SY101 TE095, WALL CNCR INSD HT01FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-101-95
SY101-TI-STRU-104	SY101 TE104, WALL CNCR OTSD HT10FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-101-104
SY101-TI-STRU-107	SY101 TE107, WALL CNCR INSD HT10FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-101-107
SY101-PDI-R17C-1-6	PT, SY101, TANK ΔP, RISER 17C	AI:4-20 MADC	-6~4	INWG	85170		PT-101-1
SY101-FI-R07A-3101A	SY101, VENT FLOW LOW RANGE	AI:4-20 MADC	0~1275	CFM		10407	VTP-FIT-3101A
SY101-FI-R07A-3101B	SY101, VENT FLOW HIGH RANGE	AI:4-20 MADC	0~4000	CFM		10407	VTP-FIT-3101B
SY101-TCSH-U3-FAN	RTU CONTROL OF COOLING FAN	DO:115 VAC	ON(1)/OFF(0)	---			NONE
SY101-TI-U3-RJA	SY101, U3, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-U3-RJB	SY101, U3, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-R17C-01	TC, SY101, RISER 17C, TE001, HT 004 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-1
SY101-TI-R17C-02	TC, SY101, RISER 17C, TE002, HT 016 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-2
SY101-TI-R17C-03	TC, SY101, RISER 17C, TE003, HT 028 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-3
SY101-TI-R17C-04	TC, SY101, RISER 17C, TE004, HT 052 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-4
SY101-TI-R17C-05	TC, SY101, RISER 17C, TE005, HT 076 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-5
SY101-TI-R17C-06	TC, SY101, RISER 17C, TE006, HT 100 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-6
SY101-TI-R17C-07	TC, SY101, RISER 17C, TE007, HT 112 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-7
SY101-TI-R17C-08	TC, SY101, RISER 17C, TE008, HT 124 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-8
SY101-TI-R17C-09	TC, SY101, RISER 17C, TE009, HT 148 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-9
SY101-TI-R17C-10	TC, SY101, RISER 17C, TE010, HT 172 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-10
SY101-TI-R17C-11	TC, SY101, RISER 17C, TE011, HT 196 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-11
SY101-TI-R17C-12	TC, SY101, RISER 17C, TE012, HT 208 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-12
SY101-TI-R17C-13	TC, SY101, RISER 17C, TE013, HT 220 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-13
SY101-TI-R17C-14	TC, SY101, RISER 17C, TE014, HT 232 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-14
SY101-TI-R17C-15	TC, SY101, RISER 17C, TE015, HT 244 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-15
SY101-TI-R17C-16	TC, SY101, RISER 17C, TE016, HT 292 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-16
SY101-TCSH-U5-FAN	RTU CONTROL OF COOLING FAN	DO:115 VAC	ON(1)/OFF(0)	---			NONE
SY101-TI-U5-RJA	SY101, U5, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE

A-6

					REF DRAWINGS		
TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	H-2	H-14-	FIELD TAG (20 CHAR)
SY101-TI-U5-RJB	SY101, U5, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-R17C-17	TC, SY101, RISER 17C, TE017, HT 316 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-17
SY101-TI-R17C-18	TC, SY101, RISER 17C, TE018, HT 340 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-18
SY101-TI-R17C-20	TC, SY101, RISER 17C, TE020, HT 392 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-20
SY101-TI-R17C-21	TC, SY101, RISER 17C, TE021, HT 402 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-21
SY101-TI-R17C-22	TC, SY101, RISER 17C, TE022, HT 427 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-101SY-17C-22
**-SY101-LI-R01A-03	LEVEL GAUGE, SY101, RISER 1A	AI:4-20 MA	370.0~470.0	INCHES	815467		WST-LIT-SY101A
SY101-TI-U6-RJA	SY101, U6, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY101-TI-U6-RJB	SY101, U6, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY102-TI-R04A-37	TC, SY102, RISER 04A, TE037 , HT 009 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-37
SY102-TI-R04A-38	TC, SY102, RISER 04A, TE038 , HT 033 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-38
SY102-TI-R04A-39	TC, SY102, RISER 04A, TE039 , HT 057 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-39
SY102-TI-R04A-40	TC, SY102, RISER 04A, TE040 , HT 081 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-40
SY102-TI-R04A-41	TC, SY102, RISER 04A, TE041 , HT 105 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-41
SY102-TI-R04A-42	TC, SY102, RISER 04A, TE042 , HT 129 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-42
SY102-TI-R04A-43	TC, SY102, RISER 04A, TE043 , HT 153 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-43
SY102-TI-R04A-44	TC, SY102, RISER 04A, TE044 , HT 177 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-44
SY102-TI-R04A-45	TC, SY102, RISER 04A, TE045 , HT 201 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-45
SY102-TI-R04A-46	TC, SY102, RISER 04A, TE046 , HT 225 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-46
SY102-TI-R04A-47	TC, SY102, RISER 04A, TE047 , HT 249 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-47
SY102-TI-R04A-48	TC, SY102, RISER 04A, TE048 , HT 273 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-48
SY102-TI-R04A-49	TC, SY102, RISER 04A, TE049 , HT 297 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-49
SY102-TI-R04A-50	TC, SY102, RISER 04A, TE050 , HT 321 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-50
SY102-TI-R04A-51	TC, SY102, RISER 04A, TE051 , HT 345 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-51
SY102-TI-R04A-52	TC, SY102, RISER 04A, TE052 , HT 369 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-52
SY102-TCSH-U1-FAN	RTU CONTROL OF COOLING FAN	DO:115 VAC	ON(1)/OFF(0)	----			NONE
SY102-TI-U1-RJA	SY102, U1, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY102-TI-U1-RJB	SY102, U1, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY102-TI-R04A-53	TC, SY102, RISER 04A, TE053 , HT 416 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-53
SY102-TI-R04A-54	TC, SY102, RISER 04A, TE054 , HT 465 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-102-54
SY102-TI-STRU-092	SY102 TE092, WALL CNCR OTSD HT01FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-102-92
SY102-TI-STRU-095	SY102 TE095, WALL CNCR INSD HT01FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-102-95
SY102-TI-STRU-104	SY102 TE104, WALL CNCR OTSD HT10FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-102-104
SY102-TI-STRU-107	SY102 TE107, WALL CNCR INSD HT10FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-102-107

TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	REF DRAWINGS H-2	H-14-	FIELD TAG (20 CHAR)
SY102-TI-STRU-112	SY102 TE112, DOME CNCR OTSD R21FT 49°	AI:TC TYPE J	-193~1400	deg F	37754		TE-102-112
SY102-TI-STRU-115	SY102 TE115, DOME CNCR INSD R21FT 49°	AI:TC TYPE J	-193~1400	deg F	37754		XTE-102-115
SY102-TI-U2-RJA	SY102, U2, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY102-TI-U2-RJB	SY102, U2, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-R04A-37	TC, SY103, RISER 04A, TE037 , HT 009 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-37
SY103-TI-R04A-38	TC, SY103, RISER 04A, TE038 , HT 033 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-38
SY103-TI-R04A-39	TC, SY103, RISER 04A, TE039 , HT 057 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-39
SY103-TI-R04A-40	TC, SY103, RISER 04A, TE040 , HT 081 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-40
SY103-TI-R04A-41	TC, SY103, RISER 04A, TE041 , HT 105 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-41
SY103-TI-R04A-42	TC, SY103, RISER 04A, TE042 , HT 129 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-42
SY103-TI-R04A-43	TC, SY103, RISER 04A, TE043 , HT 153 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-43
SY103-TI-R04A-44	TC, SY103, RISER 04A, TE044 , HT 177 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-44
SY103-TI-R04A-45	TC, SY103, RISER 04A, TE045 , HT 201 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-45
SY103-TI-R04A-46	TC, SY103, RISER 04A, TE046 , HT 225 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-46
SY103-TI-R04A-47	TC, SY103, RISER 04A, TE047 , HT 249 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-47
SY103-TI-R04A-48	TC, SY103, RISER 04A, TE048 , HT 273 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-48
SY103-TI-R04A-49	TC, SY103, RISER 04A, TE049 , HT 297 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-49
SY103-TI-R04A-50	TC, SY103, RISER 04A, TE050 , HT 321 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-50
SY103-TI-R04A-51	TC, SY103, RISER 04A, TE051 , HT 345 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-51
SY103-TI-R04A-52	TC, SY103, RISER 04A, TE052 , HT 369 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-52
SY103-TCSH-U1-FAN	RTU CONTROL OF COOLING FAN	DO:115 VAC	ON(1)/OFF(0)	----			NONE
SY103-TI-U1-RJA	SY103, U1, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-U1-RJB	SY103, U1, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-R04A-53	TC, SY103, RISER 04A, TE053 , HT 416 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-52
SY103-TI-R04A-54	TC, SY103, RISER 04A, TE054 , HT 465 IN	AI:TC TYPE J	-193~1400	deg F	34304		TE-103-53
SY103-TI-STRU-092	SY103 TE092, WALL CNCR OTSD HT01FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-103-92
SY103-TI-STRU-095	SY103 TE095, WALL CNCR INSD HT01FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-103-95
SY103-TI-STRU-104	SY103 TE104, WALL CNCR OTSD HT10FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-103-104
SY103-TI-STRU-107	SY103 TE107, WALL CNCR INSD HT10FT169°	AI:TC TYPE J	-193~1400	deg F	37754		TE-103-107
SY103-TI-STRU-112	SY103 TE112, DOME CNCR OTSD R21FT 49°	AI:TC TYPE J	-193~1400	deg F	37754		TE-103-112
SY103-TI-STRU-115	SY103 TE115, DOME CNCR INSD R21FT 49°	AI:TC TYPE J	-193~1400	deg F	37754		TE-103-115
SY103-TI-U2-RJA	SY103, U2, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-U2-RJB	SY103, U2, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-R17B-01	TC, SY103, RISER 17B, TE001, HT 004 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-1

TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	RANGE	UNITS	REF DRAWINGS		FIELD TAG (20 CHAR)
					H-2	H-14-	
SY103-TI-R17B-02	TC, SY103, RISER 17B, TE002, HT 016 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-2
SY103-TI-R17B-03	TC, SY103, RISER 17B, TE003, HT 028 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-3
SY103-TI-R17B-04	TC, SY103, RISER 17B, TE004, HT 052 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-4
SY103-TI-R17B-05	TC, SY103, RISER 17B, TE005, HT 076 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-5
SY103-TI-R17B-06	TC, SY103, RISER 17B, TE006, HT 100 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-6
SY103-TI-R17B-07	TC, SY103, RISER 17B, TE007, HT 112 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-7
SY103-TI-R17B-08	TC, SY103, RISER 17B, TE008, HT 124 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-8
SY103-TI-R17B-09	TC, SY103, RISER 17B, TE009, HT 148 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-9
SY103-TI-R17B-10	TC, SY103, RISER 17B, TE010, HT 172 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-10
SY103-TI-R17B-11	TC, SY103, RISER 17B, TE011, HT 196 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-11
SY103-TI-R17B-12	TC, SY103, RISER 17B, TE012, HT 208 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-12
SY103-TI-R17B-13	TC, SY103, RISER 17B, TE013, HT 220 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-13
SY103-TI-R17B-14	TC, SY103, RISER 17B, TE014, HT 232 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-14
SY103-TI-R17B-15	TC, SY103, RISER 17B, TE015, HT 244 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-15
SY103-TI-R17B-16	TC, SY103, RISER 17B, TE016, HT 292 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-16
SY103-TCSH-U3-FAN	RTU CONTROL OF COOLING FAN	DO:115 VAC	ON(1)/OFF(0)	—			NONE
SY103-TI-U3-RJA	SY103, U3, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-U3-RJB	SY103, U3, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-R17B-17	TC, SY103, RISER 17B, TE017, HT 316 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-17
SY103-TI-R17B-18	TC, SY103, RISER 17B, TE018, HT 340 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-18
SY103-TI-R17B-19	TC, SY103, RISER 17B, TE019, HT 364 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-19
SY103-TI-R17B-20	TC, SY103, RISER 17B, TE020, HT 392 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-20
SY103-TI-R17B-21	TC, SY103, RISER 17B, TE021, HT 402 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-21
SY103-TI-R17B-22	TC, SY103, RISER 17B, TE022, HT 427 IN	AI:TC TYPE K	-328~2502	deg F	85122		TE-103SY-17B-22
SY103-TI-U4-RJA	SY103, U4, TC REF JUNC SENSOR A	AI:INTERNAL	-16.6~143.6	deg F			NONE
SY103-TI-U4-RJB	SY103, U4, TC REF JUNC SENSOR B	AI:INTERNAL	-16.6~143.6	deg F			NONE

SHMS Parameter Monitored by TMACS

TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	LOGIC STATES	UNITS	WINDOW TEXT (26 CHAR)	REF DRAWINGS H-2-	REF DRAWINGS H-14-	FIELD TAG (20 CHAR)
AW101-TCSH-A-FAN	RTU CONTROL OF COOLING FAN	DO:115 VAC	ON(1)/OFF(0)	—				
AW101-NSH-VP1-055	AW101, SHMS-B, HIGH HYDROGEN	DI: 24 VDC	HIGH(0)/NRM(1)	—	AW-101 HIGH,HYDROGEN	817854		AW101-SHM-CR-055
AW101-NXS-VP1-063	AW101, SHMS-B, CABINET TROUBLE	DI: 24 VDC	TROB(0)/NRM(1)	—	AW-101 CABINET,TROUBLE	817854		AW101-SHM-CR-063
AW101-NSH-EXH-055	AW241, SHMS-D, HIGH HYDROGEN	DI: 24 VDC	HIGH(0)/NRM(1)	—	AW-FARM HIGH,HYDROGEN		100299	AW241-SHM-CR-055
AW101-NXS-EXH-063	AW241, SHMS-D, CABINET TROUBLE	DI: 24 VDC	TROB(0)/NRM(1)	—	AW-FARM CABINET,TROUBLE		100299	AW241-SHM-CR-063
AW101-NI-VP1-055	AW101, PERCENT HYDROGEN, SHMS-B	AI:4-20 MA	0~1	% H_2		817854		AW101-SHM-NIT-055
AW101-NI-VP1-054	AW101, PERCENT HYDROGEN, SHMS-B	AI:4-20 MA	0~10	% H_2		817854		AW101-SHM-NIT-054
AW101-FI-VP1-057	AW101, GAS SAMPLE FLOW, SHMS-B	AI:4-20 MA	0~2	CFM		817854		AW101-SHM-FIT-057
AW101-NI-EXH-055	AW241, PERCENT HYDROGEN, SHMS-D	AI:4-20 MA	0~1	% H_2			100299	AW241-SHM-NIT-055
AW101-NI-EXH-054	AW241, PERCENT HYDROGEN, SHMS-D	AI:4-20 MA	0~10	% H_2			100299	AW241-SHM-NIT-054
AW101-FI-EXH-057	AW241, GAS SAMPLE FLOW, SHMS-D	AI:4-20 MA	0~2	CFM			100299	AW241-SHM-FIT-057
SY101-NI-R16A-J-6-1	SY101, PERCENT HYDROGEN, SHMS-J	AI:4-20 MADC	0~10	% H_2		87275		NIT-01JSY-6-1
SY101-FI-R16A-J-7-1	SY101, GAS SAMPLE FLOW, SHMS-J	AI:4-20 MADC	0~2	CFM		87275		FIT-01JSY-7-1
SY101-NI-R07A-K-6-1	SY101, PERCENT HYDROGEN, SHMS-K	AI:4-20 MADC	0~10	% H_2		87275		NIT-01KSY-6-1
SY101-FI-R07A-K-7-1	SY101, GAS SAMPLE FLOW, SHMS-K	AI:4-20 MADC	0~2	CFM		87275		FIT-01KSY-7-1
SY101-NSH-R16A-J-10-1	SY101, SHMS-J, HIGH HYDROGEN	DI: 24 VDC	HIGH(0)/NRM(1)	—				BY-01JSY-10-1
SY101-NXS-R16A-J-18-1	SY101, SHMS-J, CABINET TROUBLE	DI: 24 VDC	TROB(0)/NRM(1)	—				BY-01JSY-18-1
SY101-NSH-R07A-K-10-1	SY101, SHMS-K, HIGH HYDROGEN	DI: 24 VDC	HIGH(0)/NRM(12	—				BY-01KSY-10-1
SY101-NXS-R07A-K-18-1	SY101, SHMS-K, CABINET TROUBLE	DI: 24 VDC	TROB(0)/NRM(13	—				BY-01KSY-18-1
SY102-NSH-R17B-055	SY102, SHMS-E, HIGH HYDROGEN	DI: 24 VDC	HIGH(0)/NRM(1)	—				SY102-SHM-CR-055
SY102-NXS-R17B-063	SY102, SHMS-E, CABINET TROUBLE	DI: 24 VDC	TROB(0)/NRM(1)	—				SY102-SHM-CR-063
SY102-NI-R17B-055	SY102, PERCENT HYDROGEN, SHMS-E	AI:4-20 MA	0~1	% H_2		87275		SY102-SHM-NIT-055
SY102-NI-R17B-054	SY102, PERCENT HYDROGEN, SHMS-E	AI:4-20 MA	0~10	% H_2		87275		SY102-SHM-NIT-054

TMACS TAG (30 CHAR)	DESCRIPTION (40 CHAR)	SIG TYPE	LOGIC STATES	UNITS	WINDOW TEXT (26 CHAR)	REF DRAWINGS H-2-	REF DRAWINGS H-14-	FIELD TAG (20 CHAR)
SY102-FI-R17B-057	SY102, GAS SAMPLE FLOW, SHMS-E	AI:4-20 MA	0~2	CFM		87275		SY102-SHM-FIT-057
SY103-NSH-R07A-J-10-1	SY103, SHMS-J, HIGH HYDROGEN	DI: 24 VDC	HIGH(0)/NRM(1)	—				BY-03JSY-10-1
SY103-NXS-R07A-J-18-1	SY103, SHMS-J, CABINET TROUBLE	DI: 24 VDC	TROB(0)/NRM(1)	—				BY-03JSY-18-1
SY103-NI-R07A-J-6-1	SY103, PERCENT HYDROGEN, SHMS-J	AI:4-20 MADC	0~10	% H_2		87275		NIT-03JSY-6-1
SY103-NI-R07A-J-12-1	SY103, PERCENT HYDROGEN, SHMS-J	AI:4-20 MADC	0~1	% H_2		87275		NIT-03JSY-12-1
SY103-FI-R07A-J-7-1	SY103, GAS SAMPLE FLOW, SHMS-J	AI:4-20 MADC	0~2	CFM		87275		FIT-03JSY-7-1

Appendix B
CASS Alarm/Equipment Status Signals to be Connected to TMAC

The following table is a listing of those parameters previously monitored by CASS. CASS has since been shutdown and all parameters previously monitored by CASS will be transferred over to TMACS. Work is in to transfer of these signals to TMACS. This data was obtained from WHC-SD-WM-TI-594, Rev. 3 (Draft), TMACS I-O Termination Point Listing for Tank Farms AW, AY, and SY.

CASS Alarm/Equipment Status Signals to be Connected to TMACS

TANK FARM	TMACS TAG (30 CHAR)	DESCRIPTION (35 CHAR)	SIG TYPE	WINDOW TEXT (60 CHAR)234567890123456789012345678901234567890	CASS WIRE NO--
AW	241AW271-XA-ANN-101-PWR	241-AW-271 PANEL POWER: PWR FAIL	DI:115 VAC	AW FARM ALARM PANEL; ANN-101; POWER - OFF	A-A-230-H
AW	241AW271-WSTA-WFA-131	241-AW-271 ANN-101: WIN 01	DI:115 VAC	HI LEVEL; LEAK DETECTOR; PIT 01C; (WSTA-WFA-131)	A-A-230-1
AW	241AW271-WST-PAH-111	241-AW-271 ANN-101: WIN 02	DI:115 VAC	HI PRESSURE; TANK 101; (LOW VACUUM); (WST-PAH-111)	A-A-230-2
AW	241AW271-WST-PAL-111	241-AW-271 ANN-101: WIN 03	DI:115 VAC	LO PRESSURE; TANK 101; (HI VACUUM); (WST-PAL-111)	A-A-230-3
AW	241AW271-WSTA-LDA-151	241-AW-271 ANN-101: WIN 04	DI:115 VAC	ANNULUS LEAK; DETECTED; TANK 101; (WSTA-LDA-151)	A-A-230-4
AW	241AW271-XA-ANN-102-PWR	241-AW-271 PANEL POWER: PWR FAIL	DI:115 VAC	AW FARM ALARM PANEL; ANN-102; POWER - OFF	A-A-231-H
AW	241AW271-WSTA-WFA-132	241-AW-271 ANN-102: WIN 01	DI:115 VAC	HI LEVEL; LEAK DETECTOR; PIT 02C; (WSTA-WFA-132)	A-A-231-1
AW	241AW271-WST-PAH-112	241-AW-271 ANN-102: WIN 02	DI:115 VAC	HI PRESSURE; TANK 102; (LOW VACUUM); (WST-PAH-112)	A-A-231-2
AW	241AW271-WST-PAL-112	241-AW-271 ANN-102: WIN 03	DI:115 VAC	LO PRESSURE; TANK 102; (HI VACUUM); (WST-PAL-112)	A-A-231-3
AW	241AW271-WSTA-LDA-152	241-AW-271 ANN-102: WIN 04	DI:115 VAC	ANNULUS LEAK; DETECTED; TANK 102; (WSTA-LDA-152)	A-A-231-4
AW	241AW271-XA-ANN-103-PWR	241-AW-271 PANEL POWER: PWR FAIL	DI:115 VAC	AW FARM ALARM PANEL; ANN-103; POWER - OFF	A-A-232-H
AW	241AW271-WSTA-WFA-133	241-AW-271 ANN-103: WIN 01	DI:115 VAC	HI LEVEL; LEAK DETECTOR; PIT 03C; (WSTA-WFA-133)	A-A-232-1
AW	241AW271-WST-PAH-113	241-AW-271 ANN-103: WIN 02	DI:115 VAC	HI PRESSURE; TANK 103; (LOW VACUUM); (WST-PAH-113)	A-A-232-2
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AW	241AW271-XA-ANN-104-PWR	241-AW-271 PANEL POWER: PWR FAIL	DI:115 VAC	AW FARM ALARM PANEL; ANN-104; POWER - OFF	A-A-233-H
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AW	241AW271-WST-PAH-115	241-AW-271 ANN-105: WIN 02	DI:115 VAC	HI PRESSURE; TANK 105; (LOW VACUUM); (WST-PAH-115)	A-A-234-2
AW	241AW271-WST-PAL-115	241-AW-271 ANN-105: WIN 03	DI:115 VAC	LO PRESSURE; TANK 105; (HIGH VACUUM); (WST-PAL-115)	A-A-234-3
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AW	241AW271-WSTA-WFA-136	241-AW-271 ANN-106: WIN 01	DI:115 VAC	HI LEVEL; LEAK DETECTOR; PIT 06C; (WSTA-WFA-136)	A-A-235-1
AW	241AW271-WST-PAH-116	241-AW-271 ANN-106: WIN 02	DI:115 VAC	HI PRESSURE; TANK 106; (LOW VACUUM); (WST-PAH-116)	A-A-235-2
AW	241AW271-WST-PAL-116	241-AW-271 ANN-106: WIN 03	DI:115 VAC	LO PRESSURE; TANK 106; (HI VACUUM); (WST-PAL-116)	A-A-235-3

TANK FARM	TMACS TAG (30 CHAR)	DESCRIPTION (35 CHAR)	SIG TYPE	WINDOW TEXT (60 CHAR)234567890123456789012345678901234567890	CASS WIRE NO---
AW	241AW271-XA-ANN-106-PWR	241-AW-271 PANEL POWER: PWR FAIL	DI:115 VAC	AW FARM ALARM PANEL; ANN-106; POWER - OFF	A-A-235-H
AW	241AW271-WSTA-LDA-156	241-AW-271 ANN-106: WIN 04	DI:115 VAC	ANNULUS LEAK; DETECTED; TANK 106; (WSTA-LDA-156)	A-A-235-4
AW	241AW271-VTA-PDAL-710	241-AW-271 ANN-106: WIN 09	DI:115 VAC	LOW AIR FLOW; A TRAIN; ANNULUS EXH; (VTA-PDAL-710)	A-A-235-6
AW	241AW271-VTA-PDAL-810	241-AW-271 ANN-106: WIN 10	DI:115 VAC	LOW AIR FLOW; B TRAIN; ANNULUS EXH; (VTA-PDAL-810)	A-A-235-7
AW	241AW271-WSTA-RAH-106A	241-AW-271 ANN-106: WIN 06	DI:115 VAC	CAM ALARM; TANK 106; ANNULUS; (WSTA-RAH-106A)	A-A-235-9
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AW	241AW271-VTA-RAH-910C	241-AW-271 ANN-102: WIN 09	DI:115 VAC	HI RAD ALARM; ANNULUS EXH; STACK; (VTA-RAH-910C)	A-A-231-7
AW	241AW271-VTP-RAH_XA-510B	241-AW-271 ANN-102: WIN 08 & 10	DI:115 VAC	PRIMARY EXH; STACK; CAM FAILURE; (VTP-RAH/XA-510B)	A-A-231-8
AW	241AW271-WSTA-RAH-103A	241-AW-271 ANN-103: WIN 06	DI:115 VAC	CAM ALARM; TANK 103; ANNULUS; (WSTA-RAH-103A)	A-A-232-6
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AY	241A271-PA-101AY-1	241-A-271 ANN A3: WIN 1-1	DI:115 VAC	101-AY; TANK; HIGH PRESSURE	CASS-A3-11
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SY	241SY271-WSTA-WFA-104A	241-SY-271 ANN-101: WIN 01	DI:115 VAC	HIGH LEVEL; LEAK DETECTION; PIT 01C; (WSTA-WFA-104A)	S-A-201-1
SY	241SY271-WST-PAH-313	241-SY-271 ANN-101: WIN 02	DI:115 VAC	HIGH PRESSURE; TANK 101; (LOW VACUUM); (WST-PAH-313)	S-A-201-2
SY	241SY271-WST-PAL-313	241-SY-271 ANN-101: WIN 03	DI:115 VAC	LOW PRESSURE; TANK 101; (HI VACUUM); (WST-PAL-313)	S-A-201-3

TANK FARM	TMACS TAG (30 CHAR)	DESCRIPTION (35 CHAR)	SIG TYPE	WINDOW TEXT (60 CHAR)234567890123456789012345678901234567890	CASS WIRE NO—
SY	241SY271-WSTA-LDA-107	241-SY-271 ANN-101: WIN 07	DI:115 VAC	ANNULUS LEAK; DETECTED; TANK 101; (WSTA-LDA-107)	S-A-201-5
SY	241SY271-WSTA-WFA-109A	241-SY-271 ANN-102: WIN 01	DI:115 VAC	HIGH LEVEL; LEAK DETECTION; PIT 02C; (WSTA-WFA-109A)	S-A-202-1
SY	241SY271-WST-PAH-316	241-SY-271 ANN-102: WIN 02	DI:115 VAC	HIGH PRESSURE; TANK 102; (LOW VACUUM); (WST-PAH-316)	S-A-202-2
SY	241SY271-WST-PAL-316	241-SY-271 ANN-102: WIN 03	DI:115 VAC	LOW PRESSURE; TANK 102; (HI VACUUM); (WST-PAL-316)	S-A-202-3
SY	241SY271-WSTA-LDA-112	241-SY-271 ANN-102: WIN 07	DI:115 VAC	ANNULUS LEAK; DETECTED; TANK 102; (WSTA-LDA-112)	S-A-202-5
SY	241SY271-WSTA-WFA-114A	241-SY-271 ANN-103: WIN 01	DI:115 VAC	HIGH LEVEL; LEAK DETECTION; PIT 03C; (WSTA-WFA-114A)	S-A-203-1
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SY	241SY271-WST-PAL-319	241-SY-271 ANN-103: WIN 03	DI:115 VAC	LOW PRESSURE; TANK 103; (HI VACUUM); (WST-PAL-319)	S-A-203-3
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SY	241SY271-VTA-XA-720	241-SY-271 ANN-103: WIN 09	DI:115 VAC	LOW PRESSURE; FAN SHUTDOWN; ANNULUS EXHAUST; (VTA-XA-720)	S-A-203-7
SY	241SY271-VTP-XA-321	241-SY-271 ANN-101: WIN 08	DI:115 VAC	EXHAUSTER TROUBLE; PRIMARY EXHAUST; A TRAIN; (VTP-XA-321)	S-A-201-9
SY	241SY271-WSTA-RAH_RXA-101B	241-SY-271 ANN-101: WIN 06	DI:115 VAC	HIGH RAD/SYS FAIL; TK-101 ANN MON; (WSTA-RAH/RXA-101B)	S-A-201-7
SY	241SY271-WSTA-RAH_RXA-102B	241-SY-271 ANN-102: WIN 06	DI:115 VAC	HIGH RAD/SYS FAIL; TK-102 ANN MON; (WSTR-RAH/RXA-102B)	S-A-202-8
SY	241SY271-VTA-RAH-910B	241-SY-271 ANN-102: WIN 09	DI:115 VAC	HIGH RAD ALARM; ANNULUS EXHAUST; STACK; (VTA-RAH-910B)	S-A-202-9
SY	241SY271-VTP-RAH-510B	241-SY-271 ANN-102: WIN 10	DI:115 VAC	HIGH RAD ALARM; PRIMARY EXHAUST; STACK; (VTP-RAH-510B)	S-A-202-10
SY	241SY271-WSTA-RAH_RXA-103B	241-SY-271 ANN-103: WIN 06	DI:115 VAC	HIGH RAD/SYS FAIL; TK-103 ANN MON; (WSTA-RAH/RXA-103B)	S-A-203-9

Attachment O

Attachment O

Portable Pit Decontamination Unit

PORTABLE PIT DECONTAMINATION UNIT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-004
ACDR Subtask 15
Revision 0

September 2000

prepared by

HND TEAM

PORTABLE PIT DECONTAMINATION UNIT

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September 2000

Prepared by: Eric Shen
Bruce Groth

Reviewed by: Scott Pierce, P.E.
Tom Salzano, P.E.

Approved by: RL Fritz
Robert L. Fritz

Date: 9-21-00

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Acronyms

CDR	Conceptual Design Report
LLCE	Long length contaminated equipment

1.0 INTRODUCTION

Normal operations at the Hanford Site Tank Farms requires the performance of various modifications in the process pits via a combination of long reach tools and manual methods. These modifications include replacement or installation of jumpers for the redirection of waste transfers, removal and/or replacement of valve jumpers, removal and reinstallation of process pumps, decontamination of the pits, and the potential need to maintain/restore secondary containment capability within the pits. Over the course of many years of operation, these pits have become contaminated with radioactive material from leaks and spills. In some cases, general radiation levels in the pits have reached as high as 40 r/hr, although 300 mr/hr is a conservative average. The elevated radiation levels in the pits increase the difficulty of performing work with the cover-blocks removed because of the need to minimize personnel radiation exposure and prevent personnel contamination. The added complexity associated with working in radiation environments impacts the cost and schedule of projects requiring pit modifications and hence, a number of concepts for employing remote systems to perform work in the pits have been investigated over the years.

In the near future, a large number of pits will need to be entered for modifications by Projects W-211 *Initial Tank Retrieval Systems*, W-314, *Tank Farm Restoration and Safe Operation*, and W-521, *Waste Feed Delivery System*. This study evaluates the need to implement and/or expand remote system methodologies in support of these upcoming projects.

2.0 BACKGROUND AND PURPOSE

Several studies have been conducted on the use of remote systems over the years; however, PNNL-13046, Rev. 0, *Remote Pit Operation Enhancement System: Concept Selection Method and Evaluation Criteria* (Bailey 1999), gives the best overview and evaluation of currently applicable technologies. This study, developed in support of Project W-314, identifies top-level functions and requirements for the operations and modifications to be performed in the process pits, identifies technology options, and evaluates each option. A preferred alternative was selected using a multi-attribute decision analysis technique. The selected option is based upon mounting a teleoperated manipulator arm on a tractor-mounted backhoe. Using this approach, many of the high dose and time intensive tasks associated with tank pit modifications are accomplished by using a teleoperated manipulator, thus avoiding the personnel dose accumulated from conducting these tasks manually. In addition to the exposure reducation, the schedule to complete tasks of this nature can often times be reduced significantly because of improved manipulative capability and the addition of camera viewing in the remote location.

One of the near term Tank Farms projects is Project W-521. This project will require entry into a total of 16 pits for major modifications. The Conceptual Design Report (CDR) for Project W-521 is based upon the current practice of manual entry to implement these modifications. The large number of pits requiring modifications suggests significant cost and personnel exposure improvements are possible using remote methodologies. The PNNL-13046 (Bailey 1999) study is very thorough; however, the scope of the study was focused upon jumper removal/installation/disposal and potentially pit maintenance and repair. The cost estimate in the CDR indicates that additional cost/schedule savings, along with reductions in radiation exposure, may be possible with an expansion of the remote systems scope beyond what was considered in the earlier study. This report focuses upon identifying and breaking down the tasks associated with the pit modification work, evaluating these tasks, identifying and developing remote systems concepts. In addition, recommendations for expanding the scope covered in the PNNL-13046 (Bailey 1999) study would, when implemented, result in improvements to cost, schedule, and/or radiation exposure.

3.0 METHODOLOGY

The detailed analysis of each task conducted during pit modifications was the basis for this assessment. A cost associated with completing each task and the cumulative dose taken by the work team are used in judging whether adopting or expanding remote systems capability will be beneficial. The main process steps involved are identified on a flow chart, followed with a listing of the various subtasks that make up that task. The task analysis steps and subtasks were identified by breaking down the process steps captured on a video from a previous pit entry. Personnel with Hanford Tank Farms operations experience explained specific details of the process captured on the video. The task analysis also details the number of personnel required to accomplish a particular task, estimates the time duration required to complete the task, and provides an estimate of the average radiation field that the personnel must work in. The cost to complete each task is derived from the Project W-521 CDR cost estimate and/or actual costs from similar previous jobs. The task analysis is shown as Figure 3-1.

The radiation dose that personnel receive while performing tasks and the overall costs to complete the tasks are areas of concern when manned entries into radiation zones are required. A focus of the task analysis is to provide a quantitative baseline which can be used to compare options and alternatives. The task analysis estimates that 28 person-rem is absorbed during the normal pit entry at a cost of $1.2 million to complete the designated tasks. The absorbed dose is an estimate based upon typical background dose of 300 mr/hr (before jumper removal and pit decon activities). It is unlikely that all pits will have background doses at this level, but for the purposes of this study, an estimated value provides a uniform basis for comparing options.

4.0 CONCEPT APPROACHES

Three concepts were identified either as part of this study or developed as a part of prior studies. These three concepts were selected because they represent a realistic range of remote system options that could reduce radiation exposure and cost. The options go from a totally remote concept where a tent structure is unnecessary, to the minimum approach where additional manipulative capability is added to eliminate people from the most dose intensive activities. The three options are compared to the totally manual baseline approach to establish potential improvements to cost and dose. A brief description of each concept follows:

Radiation Survey → **Site Preparation** → **Build Containment** → **Apply Fixative** → **Cover Block Removal** → **Break Hanford Connector** →

Radiation Survey

- Partial Pit Survey - thru access ports
- Survey area around pit

- $42K/Pit

Site Preparation

- Protect Equipment
- Cover area surrounding pit

- Mobilization *100T* crane: $2K
- 40T crane: $1K
- No spark tools: $15K
- Rad shield plugs: $4K ea.
- Training: $40K

Build Containment

- Erect tent with airlock & step off pad
- *Install* monitor equipment (air monitoring)
- Size: 24' x 30' x = 12'
- Buy off containment

- Tent: $12K (*use existing* scaffold)
- Tent erect: $9.4K

Apply Fixative

- Spray interior of pit with sugar/water/ glycerine fixture

Cover Block Removal

- Blocks *lifted with* overhead crane
- Double wrap block *with* reinforced poly propylene
- Swipe survey for *contamination*
- Mainly a contamination problem (1 in 15 jobs lose contamination *control*)
- Set down blocks outside tent
- Blocks weigh from 5 T to 15 T

- 14 people involved, 4-5 in rad field at anytime - 6 day job overall
- Each block req'd about 15-25 min x 4 blocks

- *Dose at pit edge* range 50 mrem to 5000 mrem/hr avg 300 mrem/hr
- *Dose = 4 people* x 4 blocks x 20 min x 5 mrem/ hr = 1600 mrem

---

- Pit O1A cost $53.4K for cover block removal

Break Hanford Connector

- Unwrap impact wrench & hang from overhead crane
- Position impact wrench onto connector using pole *hook for guidance*
- Set jumper on pit floor

- *13 people involved*, 3-4 in rad field at anytime
- *Job requires about 10* min per connector (= 20 min total)

- *High dose* job since staff must be near pit edge
- Dose = 3 people x 7 *jumpers x 20min x 5* mrem/min = 2100 mrem

<u>Assumptions</u>

- Crane on station throughout the listed operations. For current *practice*
- *Assume 7 jumpers/pit*
- 1 IND/HYGENE: $3K/mon
- Green House Maint: $2K/pit
- Radwaste Drums & Fee/pit: $20K
- Foreman OT: $4K/mon
- Butler: $2K/pit
- Assume avg field 300 *mrem/hr edge of pit* with no decon & jumpers in place
- W-521 has 39 valve & pump pits

	Radiation Survey	Site Preparation	Build Containment	Apply Fixative	Cover Block Removal	Break Hanford Connector
Current Practice $ / Dose	$51K	$62K	$22K	$10K	$53K *1600mrem*	$ *in next task* 2100mrem
Concept A $ / Dose	$10K	$62K	$2K (6 Ops x 8hrs)		$2K	$ *in next task*
Concept B $ / Dose	$49K	$62K	$2K (6 Ops x 8hrs)		$53K 1600mrem	$ in next task
Concept C $ / Dose	$51K	$62K	$28K (more special features)	$10K	$53K *1600mrem*	$ *in next task*

Figure 3-1. Task Analysis (Sheet 1 of 3).

Connector Seal Replacement

- Relocate jumper for hands on access to connector
- Replace seal
- Not a contamination problem unless careless
- Reposition to oppisite end & repeat replacement

- 15 People involved
- 20-30 min job/seal

- High dose - 350 mrem whole body, maybe 1000 mrem/hr extermity
- 4-5 people in rad field

Prepare Jumper(s) for Disposal

- Prepare Guillotine cutter and mount on crane hook
- Lower into pit and position onto pipe using long pole hook to assist
- Cut pipe
- Repeat above until *all jumpers* to be disposed of have been cut
- Contamination is a risk during *unbagging*/bagging of cutter

---

- 15 people involved -- 10-15 min/cut
  4 in rad field at any time

- High dose since operators need to be near edge of pit - 200 to 1000 mrem/hr
- *Dose* = 4 people x 7 cuts x 15 min x 5.0 mrem/*min* = 2100 mrem

---

- 7 jumpers- break & remove: $73K
  $60K Labor (*15 people* x 100hrs)
  $13K Equip (*cranes, forklift*, etc)
  $19.6K Matl.

Remove Long Length Contaminated Equipment

- Install *LLCE system*
- Sling component to be removed and attach to crane
- Withdraw component into bagging system
- Install 2nd bag
- Place into *LLCE* box
- 1 item per tank, up *to* 30 items total

Remove Equip for Disposal

- Sling & remove equip from pit
- Double bag component at the pit edge
- Place component into box
- High dose - operators near pit edge 200 to 1000 mrem/hr
- Risk of contamination *is high*

- 15 people involved
- 4 Jumpers/pump pit
  10-12 jumpers/valve pit each cut into 2-3 pieces

- 10 to 15 min req'd per piece
- Dose = 4 people x 14 pieces x *15min* x 5.0 mrem/min = 4200 *mrem*

- 5x5x9 *burial boxes*: $37K

Seal off Penetrations & Decon Pit Area

- Seal off open *penetrations*
- Remove loose contamination & dirt (wash into tank)
- Wash down walls & floor
- Assume a factor of 3 reduction dose following decon operations
- Temporary cover blanks

- 3-4 Days to *remove debris* & wash walls/floor using 150 psig hot water
- 8 people, 3 in 50-100 mrem/hr rad field at any time:
  3 OP
  2 HPT
  1 PIC
  1 IND/HYGENE
  1 QC

- Blank based on Hanford connector costs : approx. $60K
- Entire jumper costs: $80K-$100K
- Decon the pits & surface prep: $75K/pit
- Remove riser blind flange: $10K ea. (assume 1)
- Blank fab & install: $20K (for 12 blanks)

- Dose = 3 *people* x 24 hr x 100 mrem/hr = *7200 mrem*

Repair Cracks in the Pit

- Conduct structural survey of pit
- Prep & repair cracks (if required)
- Cut in additional pit *penetrations* req'd for new *mission*
  - Excavate outside pit to *create access* for core drill
  - *Place core drill*
  - *Drill penetration*
- AY was high in # of cracks, use 1/2 as basis for avg pit

- Crack repair takes crew of 8:
  2 OP
  2 HPT
  1 PIC
  1 IND/HYGENE
  1 QC
  1 *Milwright*
- 3 days

- Crack repair: *$10K*
- Core drilling: $15K
- Core drill pit excav.: $14K
- *Shoring*: $3K

- 2 *people in* rad field at any time
- Dose = *2 people* x 3 days x 8 hr/day x 100 *mrem/hr* = 4800 mrem

	Prepare Jumper(s) for Disposal	Remove Equip for Disposal	Seal off Penetrations & Decon Pit Area	Repair Cracks in the Pit
Current Practice $ / Dose	$73K 2100 *mrem*	$46K 4200 mrem	$105K 7200 mrem	$42K 4800 mrem
Concept A $ / Dose	$43K (1/2 effort)	$46K (Less access prob. more bagging)	$40K (1/4 decon effort)	$42K (1/3 dose for ex-pit work) 1600 mrem
Concept B $ / Dose	$43K (1/2 effort)	$46K (Less access prob. more bagging)	$40K (1/4 decon effort)	$42K (1/3 dose for ex-pit work) 1600 *mrem*
Concept C $ / Dose	$43K (*1/2 effort*)	$46K(Less access prob. more bagging)	$40K (1/4 decon effort)	$42K(1/3 dose for ex-pit work) 1600mrem

Figure 3-1. Task Analysis (Sheet 2 of 3).

→ Restore *Pit Liner* Integrity → Install New Components → Install Cover Blocks → Decontaminate Area within Tent → Break Down Tent → Conduct Site Survey

Restore *Pit Liner* Integrity

- Prepare surface for *liner* or coating

- Apply coating or liner

- Back fill any *pit* excavations

- *Painting* done with long *reach* rollers

- 2 Days

- Same crew but 2 painters

- Surface prep & *paint*: $10K

- Backfill: $12K

- Dose = 3 people x 16 hr x 100 mrem/hr = 4800 *mrem*

Install New Components

- Remove temporary blanks - 10 min each
2 people

- Install any *long length* equipment

- Install new/existing jumpers, 20 min/*jumper*, 3 people

- Apply valve/jumper/ component numbers, 2 days

- LLE take 1 day/item
• Same crew plus:
3 rigger
1 super
1 crane op
• people are outside the pit

- Test jumpers

- Photogrametry: $64K/pit

- Jumper fab: $25K-$55K *ea.*

- Jumper install: $25K ea.

- *Dose* = 3 *people* x 7 jumpers x 20 min x .833 *mrem/min* = 350 mrem
+
2 people x 12 blanks x 10 min x .833 mrem/min = 200 mrem

Install Cover Blocks

- Blocks lifted with overhead crane

- *Unwrap blocks*

- Set blocks in place

- Dispose of wrapping

- 1/3 Dose of that to remove blocks, same crew size

- New cover blocks: $63K

- Install cover blocks: $45K

Decontaminate Area within Tent

- Area inside of tent deconned by *wet* wipedown

- Contmination of crew can be a problem

- 1 Day wipedown with:
2 OP
2 HPT
1 PIC

Break Down Tent

- Tents infrequently *reused* ≈ 20%

- *Disposed of as* rad waste *in a* burial box

- Not a contamination problem for crew

- *1/2 Day with 5 people* involved:
3 OPs
1 HPT
1 PIC

- Tent *tear-down:* $12K (includes decon)

Conduct Site Survey

		Restore Pit Liner Integrity	Install New Components	Install Cover Blocks	Decontaminate Area within Tent	Break Down Tent	Conduct Site Survey	TOTALS
Current Practice	$	$22K	$617K	$53K		$12K		$1,168K
	Dose	4800 mrem	*550 mrem*	533 mrem				27,988 mrem
Concept A	$	$22K	$491K (install 1/4 cost)	$2K				$762K
	Dose							1600 mrem
Concept B	$	$22K	$491K(install 1/4 cost)	$53K				$903K
	Dose			533 mrem				3733 mrem
Concept C	$	$22K	$491K(install 1/4 cost)	$53K		$12K		$953K
	Dose			533 mrem				3733 mrem

Figure 3-1. Task Analysis (Sheet 3 of 3).

4.1 Portable Structure, Including Coverblock Storage – Concept A

Concept A employs a steel box structure that goes around and above the pit (see Figure 4-1). Concept A is designed to completely eliminate the need to install a tent around the pit. The box structure houses a gantry crane and a teleoperated arm that would be used to complete all in-pit modification tasks and remove and store cover blocks. The totally enclosed gantry crane is sized to be able to lift the largest cover blocks and relocate the cover blocks to a designated transfer location. The box would also have an attached annex in which the shield blocks could be stored. Because the bottom contains a sliding gate, the entire structure could be isolated from the outside environment and hence decon would be optional. The entire structure would be relocated from pit to pit via crane and tractor-trailer.

This approach is a significant improvement above the baseline manual approach. Almost all of the dose is eliminated except for that absorbed while excavating on the exterior of the pit and core drilling for new penetrations. The costs associated with erecting and later disposing of the tent structure are no longer required. In addition, the dose and cost associated with decontamination work needed to support a manned entry are not required. A design challenge associated with this concept will be to develop a workable interface with the long length contaminated equipment (LLCE) transfer system. Concept A should be designed to be as compact as possible to enhance transportability. However, the LLCE transfer system will require a larger box structure and top opening to allow the transfer system to be lowered onto the pit.

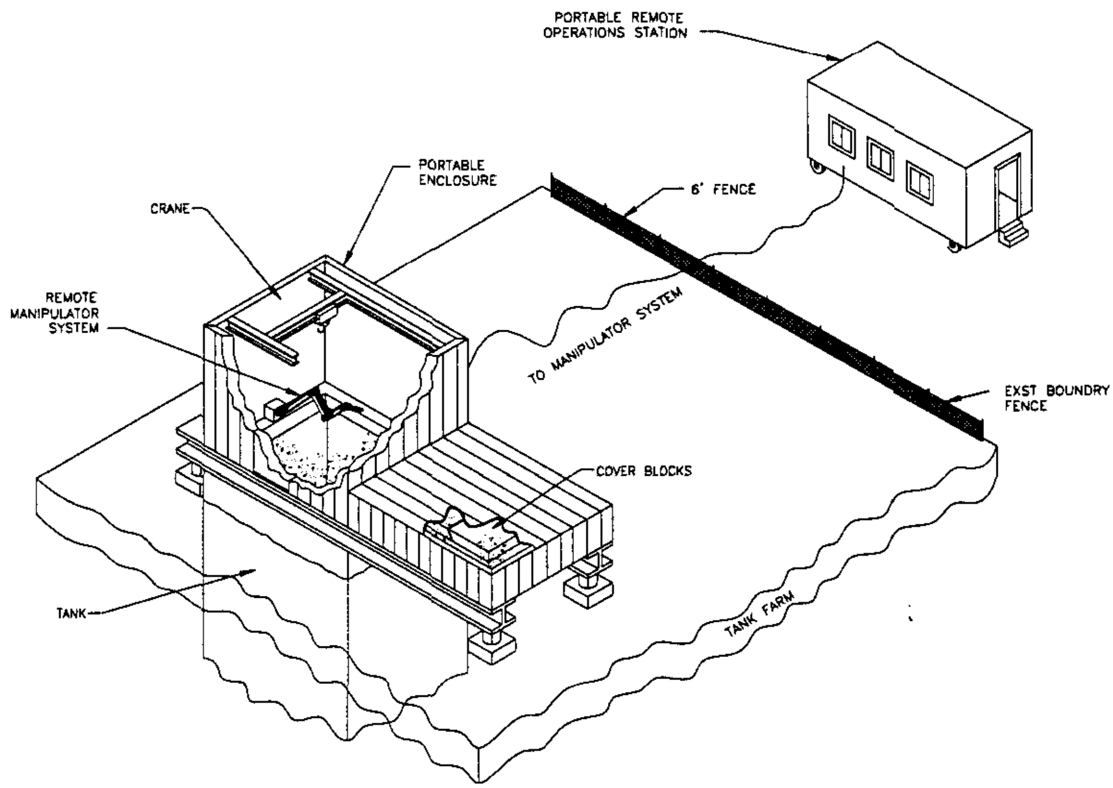

Figure 4-1. Concept A – Portable Structure with Coverblock Storage.

4.2 Portable Structure - Concept B

Concept B is similar to the box approach described for Concept A except the cover blocks are not stored inside the box (see Figure 4-2). This approach was originally proposed in WHC-SD-W467-CDR-001, Rev. 1, *Conceptual Design Report: Portable Remote DA Operations and Decontamination Unit* (Groth 1996). The main box is larger to accommodate personnel entry to support cover block removal and the top is easily opened for block removal. The gantry crane is smaller since it will not be used to lift the cover blocks. A teleoperated arm and deployment system similar to that used in Concept A is incorporated into this system. Though the box is larger, the isolation and transport features are similar to Concept A.

Concept B is almost as effective as Concept A from a dose reduction standpoint. Approximately two additional person-rem are absorbed, but this is still a 24 person-rem improvement over the baseline manual approach. Additional costs associated with cover block removal and re-installation also incurred with this concept.

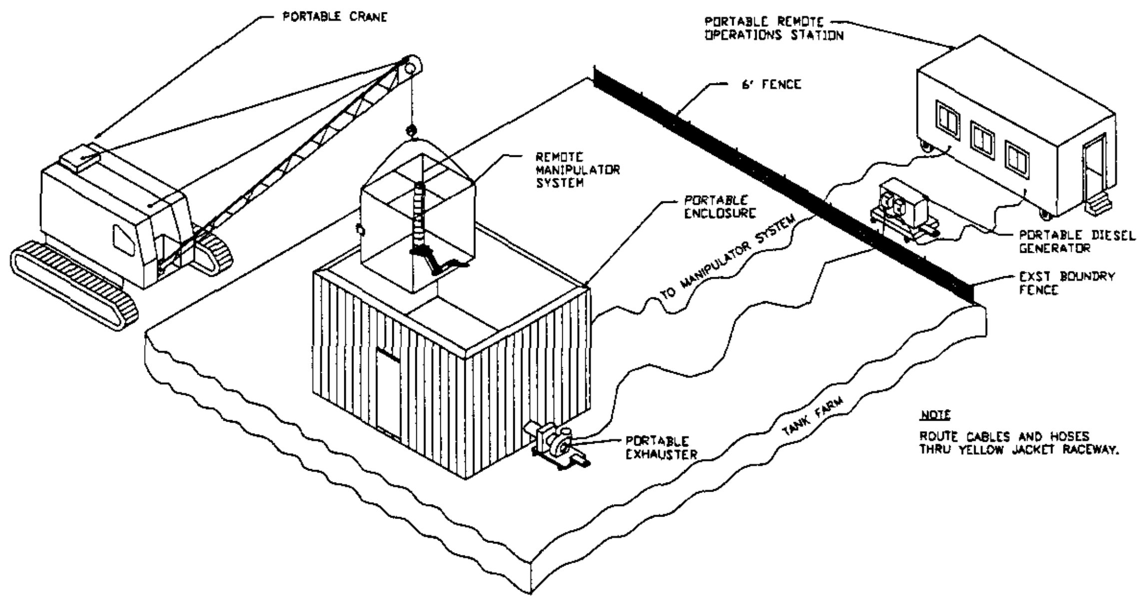

Figure 4-2. Concept B - Portable Structure with Coverblock Storage.

4.3 Backhoe/Remote ARM - Concept C

This approach utilizes the current practice of deploying a tent structure around the outside of the pit, but incorporates a teleoperated arm mounted on a backhoe to perform the time and exposure intensive tasks remotely (Bailey 1999) (see Figure 4-3). The backhoe arm projects through an opening in the tent and then lowers the teleoperated arm into the pit. Tasks, such as jumper removal and replacement, seal replacement, etc., are conducted remotely using this system. All other operations are completed as described under the current practices baseline.

Surprisingly, the dose reduction improvement is the same for this concept as in Concept B. Very little dose is received during the erection and removal of the tent structure, which is the main difference between the two approaches. Concept C provides the least improvements to the remote handling capability. The improvements are, however, sufficient to complete the most dose rate intensive and time-consuming activities with minimal manual assistance.

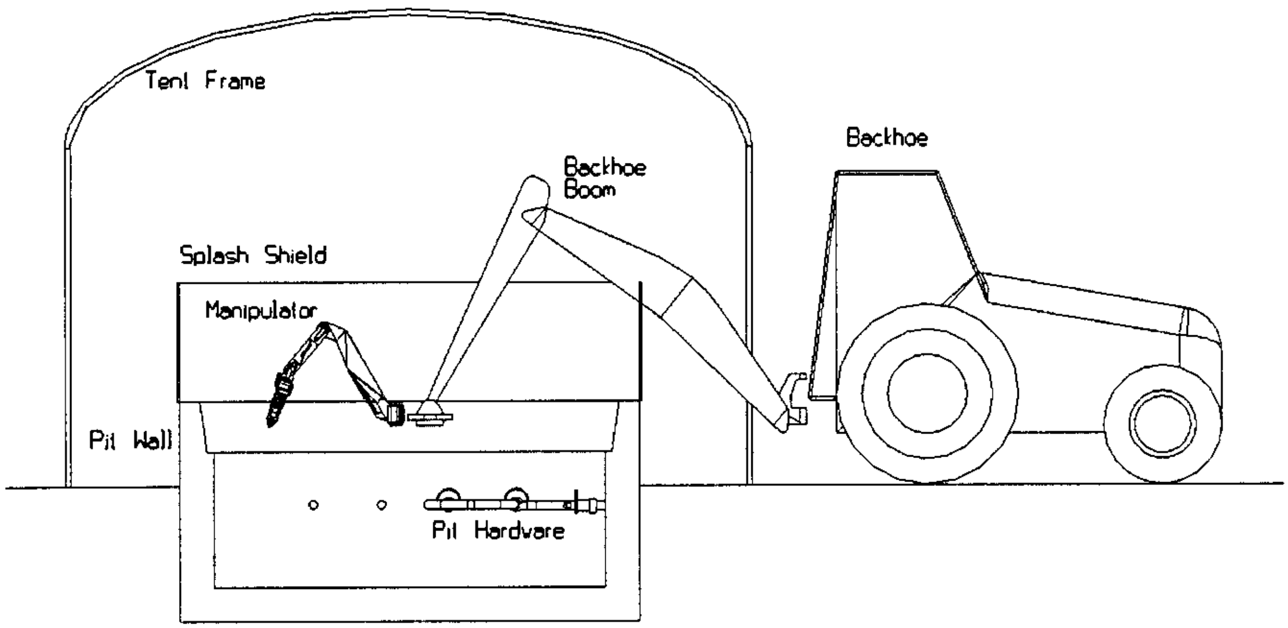

Figure 4-3. Concept C - Backhoe with Teleoperated Arm.

5.0 COSTS

The cost evaluation consists of identifying potential cost reductions. The baseline current practices costs are compared with each of the other concepts for cost reduction potential. These cost reductions do not factor in the costs needed to develop, fabricate, and field Concepts A, B, or C. The cost baseline for the current practice was developed using a combination of two methods to establish a cost for completing a particular task. The first method involved extracting the transfer pit modification portions of the CDR cost estimate developed for Project W-521. The second method involved developing a work time line and crew size using interviews with personnel with related tank farm experience. The work time line and crew size information was then multiplied by the unburdened labor rates for each task to arrive at a bottom line cost for labor. Materials and procured items were added to the labor to arrive at a total cost. In general, the two methods of estimating costs resulted in answers that were very close in value. The time line developed for this second method was also used in determining the personnel radiation exposure received. The results of both of these activities have been summarized on the bottom lines of the task analysis shown as Figure 3-1.

The costs to develop, fabricate, and install Concepts A, B, C are less meaningful since Project W-521 will follow Projects W-314 and W-211. By the time W-521 starts pit refurbishment, the remote systems needed will have been fielded and proven. The estimate for Project W-521 should include the costs to procure two systems in the event the units procured by the other projects are unavailable. For information purposes, cost estimates for Concepts A, B, and C are provided in Appendix A.

Though not a significant cost for the purposes of this study, the W-521 cost estimate should provide an allowance for personnel training. A successful approach used in the past has been to put a number of potential candidates through a "familiarization" training program that extends two weeks. This allows some judgments to be made concerning which operators are likely to pass a qualification program. "Familiarization" training would be followed by a four week qualification training program with those operators that are considered most likely to adapt to and excel at remote handling tasks.

6.0 RESULTS

The results for each subtask accomplished under each concept are shown in Figure 3-1. The summary comparisons of radiation exposure and overall costs are shown below.

6.1 Radiation Exposure Comparison

The results of the task analysis showed that a significant decrease in total personnel radiation dose is possible by deploying a teleoperated arm to assist with the time intensive activities associated with work in the waste transfer pits. A reduction of 24 person rem is the projected benefit. The difference between deploying a fully self-contained box system (Concept A) versus the arm on a backhoe approach (Concept C) produced a smaller gain. The exposure reductions do not justify additional cost and complexity of deploying a self contained system (a further reduction of 2 person-rem is projected).

A typical radiation source of 300 mrem/hr was used as the baseline for comparing options along with a factor of three decontamination factor. This may be overly conservative, so a sensitivity study was performed using a background dose of 100 mrem/hr coupled with a decontamination factor of 10. As would be expected, the dose accumulated for the current case dropped considerable (5,200 person mrem vs 28,000 person mrem). However, the reduction in benefit does not alter the conclusions of this study, since a total of 16 pits will have to be refurbished. In that context, the reduction in radiation dose is still very significant.

6.2 Cost Comparison

An evaluation of the potential cost reductions by employing remote systems technology were conservatively estimated using a combination of actual costs from similar jobs and the cost estimates from the Project W-521 CDR. The results from comparing the three concepts against the current practice baseline showed a progressively increasing cost savings with Concept A producing the greatest operations cost reductions ($405,000) and Concept C resulted in the least of the three (approximately $215,000). These numbers are conservative because the labor dollars are direct dollars. If job site adders are included , for such things as special work permits, the cost differences between the various concepts and the baseline increase. However, for the purposes of this evaluation, the cost adders do not change the results or alters the conclusions.

7.0 RECOMMENDATIONS AND CONCLUSIONS

The results from this study indicate that the adoption of Concept C, the teleoperated arm mounted on a backhoe is the best overall solution. These conclusions are clearly driven by dose reduction considerations. The cost differences between the remote systems options do not recommend one approach above the other. From a dose reduction viewpoint, the task analysis shows a significant advantage in adopting any of the remote systems concepts. However, the self-contained box approach, Concept A, represents only a small improvement in dose reduction over the less costly, more proven Concept C. This reduction is too small to be meaningful in light of the significant increase in upfront costs and technological risks associated with developing a fully self-contained system.

The cost reduction evaluation shows an advantage for Concept A, but when other factors, such as the cost to design/fabricate/test/deploy the more complicated system are factored in, the advantage becomes less significant. The other issue associated with the interface of the LLCE removal system will add to the complexity in successfully designing and fielding Concept A. Finally, as a result of the PNNL-13046 (Bailey 1999) study, a prototype for Concept C is already funded and development is slated to start next fiscal year. With these considerations in mind, the arm on the backhoe, Concept C, appears to be the most effective and lowest risk approach to reducing dose and costs.

7.1 Cost

The cost reduction associated with these additions is shown in Table 7-1.

Table 7-1. Cost

PORTABLE PIT DECON - REDUCTION FROM CDR												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$2,451,916	-$1,196,122	-$331,350	-$87,547	-$111,423	-$47,753	-$39,794	-$99,485	-$95,505	-$905,576	-$1,203,451	-$1,710,983	-$8,280,905

8.0 REFERENCES

Bailey, S.A., et al., 1999, *Remote Pit Operation Enhancement System: Concept Selection Method and Evaluation Criteria*, PNNL-13046, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

Groth, B.D., et al., 1996, *Conceptual Design Report: Portable Remote Pit Operations and Decontamination Unit, Project W-467*, WHC-SD-W467-CDR-001, Rev. 1, ARES Corporation, Richland, Washington.

Riesenweber, S.J. and Thurkow, T.J., Letter Report, *Investigation of Alternatives for a Portable Valve Pit Decontamination Unit*, ARES Report No. 961131-002, Rev. 0, prepared for Westinghouse Hanford Company by ARES Corporation, Richland, Washington.

Appendix A
Cost Estimates for Concepts A, B, and C

Cost Estimates for Concepts A, B, and C

The following cost estimates were developed by extrapolating the conceptual design cost estimate from WHC-SD-W467-CDR-001, Rev. 1 (Groth 1996), which is Concept B. Since the actual development and per copy costs for the pit modification equipment are not expected to be borne by Project W-521, the estimates are provided for comparison and information only.

Concept A - Fully Enclosed System with Shield Block Annex

This is very similar to Concept B except an annex has been added for the handling and storage of the pit cover blocks. Therefore, the costs estimates for Concept B are escalated to today's dollars with an additional $100,000 tacked on for the annex and handling equipment.

Concept A - $1.9 million for the first unit

Concept B - Fully Enclosed System

The estimate for Concept B is developed in detail in WHC-SD-W467-CDR-001, Rev. 1 (Groth 1996). A 15 percent escalation factor has been applied to this number to bring the estimate current in today's dollars. This estimate includes the costs for design, fabrication, safety, permit, test, and the startup of this equipment.

Concept B - $1.8 million for the first unit

Concept C - Arm on a Backhoe

The arm on a backhoe estimate is developed by substituting the costs for fabricating and delivering this equipment into the cost estimate for Concept B. All other elements remain the same.

Concept C - $1.3 million for the first unit (assuming $425,000 for design and fabrication)

Attachment P

Attachment P

Diluent System Piping Tie-ins Refinement

DILUENT SYSTEM PIPING TIE-INS REFINEMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-014
ACDR Subtask 16
Revision 0

September 2000

prepared by

HND Team

DILUENT SYSTEM PIPING TIE-INS REFINEMENT

PROJECT W-521, WASTE FEED DELIVERY SYSTEMS

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Contract 4412, Release 46
Report No. 990920203-014
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Revision 0

September 2000

Prepared by: Tom Salzano, P.E.

Approved by: RJ Fritz for
Larry Shipley, P.E.

Date: 9-30-00

Table of Contents

Tables

Figures

1.0 INTRODUCTION

Project W-521, Waste Feed Delivery System Project, is installing transfer and mixer pumps in several double-shell tanks (DSTs) within the 241-AW, -AY, and –SY Tank Farms. Both the transfer and mixer pumps require diluent for in-line dilution and/or flushing. During the conceptual design of Project W-521, diluent was fed to the transfer pumps via existing slurry (SL) lines that ran from their corresponding valve pits. To provide diluent to the mixer pumps, new diluent lines were routed to each mixer in the AW and AY Tank Farms. In the SY Tank Farm however, the diluent was fed to the mixer pumps by tying into the existing SL line. This approach proved to be very expensive since the existing SL lines will have high radiation doses. Therefore, a Diluent System Piping Tie-In Refinement task was identified for the Project W-521 Advanced Conceptual Design (ACD).

1.1 Purpose

The purpose of this ACD Task was to evaluate available options and make a recommendation as to the most appropriate and cost effective way to route diluent to the mixer pumps in the SY Tank Farm.

1.2 Scope

The scope of this Diluent System Piping Tie-In Refinement task first involved refining the flow requirements for diluent to the mixer pumps based on the latest Level 2 Specifications. After refining the requirements, other feasible options were developed and evaluated from a cost and technical perspective.

2.0 METHODOLOGY

The process followed consisted of a review of the latest *Double-Shell Tank Mixer Pump Subsystem Specification*, HNF-4164, and the *Mixer Pump System Design Description*, W-521-SDD-03, to determine the latest diluent flow requirements to the mixer pumps. Drawings for the different options were then developed and a cost analysis was completed to determine the best option.

3.0 ASSUMPTIONS

The following assumptions were made:

1. No additional trenching would be required for routing individual diluent lines to the mixer pumps. These lines would share trenching with the new process waste lines already being installed.

2. The existing service water line to the 241-SY-A Valve Pit can be easily tied into (i.e., no radiation concerns).

4.0 DISCUSSION

4.1 Requirements

The first effort involved with the tie-in refinement task was to review the diluent flow requirements to the mixer pumps from the latest Level 2 specification and the project's system design description. From these documents, the following requirements were identified:

- The DST Mixer Pump Subsystem shall be flushed with raw water at 200 gal/min minimum at 80 lbf/in^2 for internal pump washdown and internal cavity flush (ref. HNF-4164, Section 3.1.2.1.3).
- The DST Mixer Pump System shall accept and route externally supplied water/diluent to the pump cavity for flushing and to the pump suction area for waste dilution during startup/operation for addition of bulk dilution water for waste displacement below the pump during installation and, depending on design, water to fill the column and pressurize mechanical seals (ref. W-521-SDD-03, Section 3.1.1).

The DST Mixer Pump System shall also provide for the flush water and diluent which are fed to the SY Tank Farm from the diluent system installed by Project W-058. Project W-521 will modify this diluent system to meet the new Level 2 specification requirements. Besides adding the diluent system, Project W-058 installed a new 3-in. service water line. This new line comes in from the north side of the SY Tank Farm between tanks SY-101 and SY-102 and terminates at Nozzle L14 in the 241-SY-A Valve Pit.

4.2 Options

As stated earlier, the conceptual design basis was to tie-in to the existing slurry lines as shown in Figure 4-1. These are however, only 2-in. lines and the requirement to feed 200 gal/min to the mixers would require a velocity of more than 19 feet/sec in these 20-year-old lines (ref. Crane). In addition, over the last 20 years these lines have been used to transfer highly radioactive slurry waste. The exposure rates near this line are expected to be very high, making a tie-in to these lines difficult and costly.

The most obvious alternative would be to run individual feed lines from the valve pits to the mixer pump pads. These 3-in. service water lines would share the same trench as the new transfer lines that are being routed from the valve pits to the central pump pit of each tank. The new service water lines would originate from a single tie-in point on the existing 3-in. service water line directly between tanks SY-101 and SY-102 as shown in Figure 4-2. From this tie-in point, a new 3-in. line would be routed to each mixer and, at 200 gal/min, these new lines would feed the mixer pumps at an acceptable velocity of 8.5 feet/sec (ref. Crane). No additional trenching beyond what was in the CDR would be required since the new service water lines would be routed with the new transfer lines and/or electrical trenching. This option would however, add approximately 250-feet of 3-in. stainless steel piping.

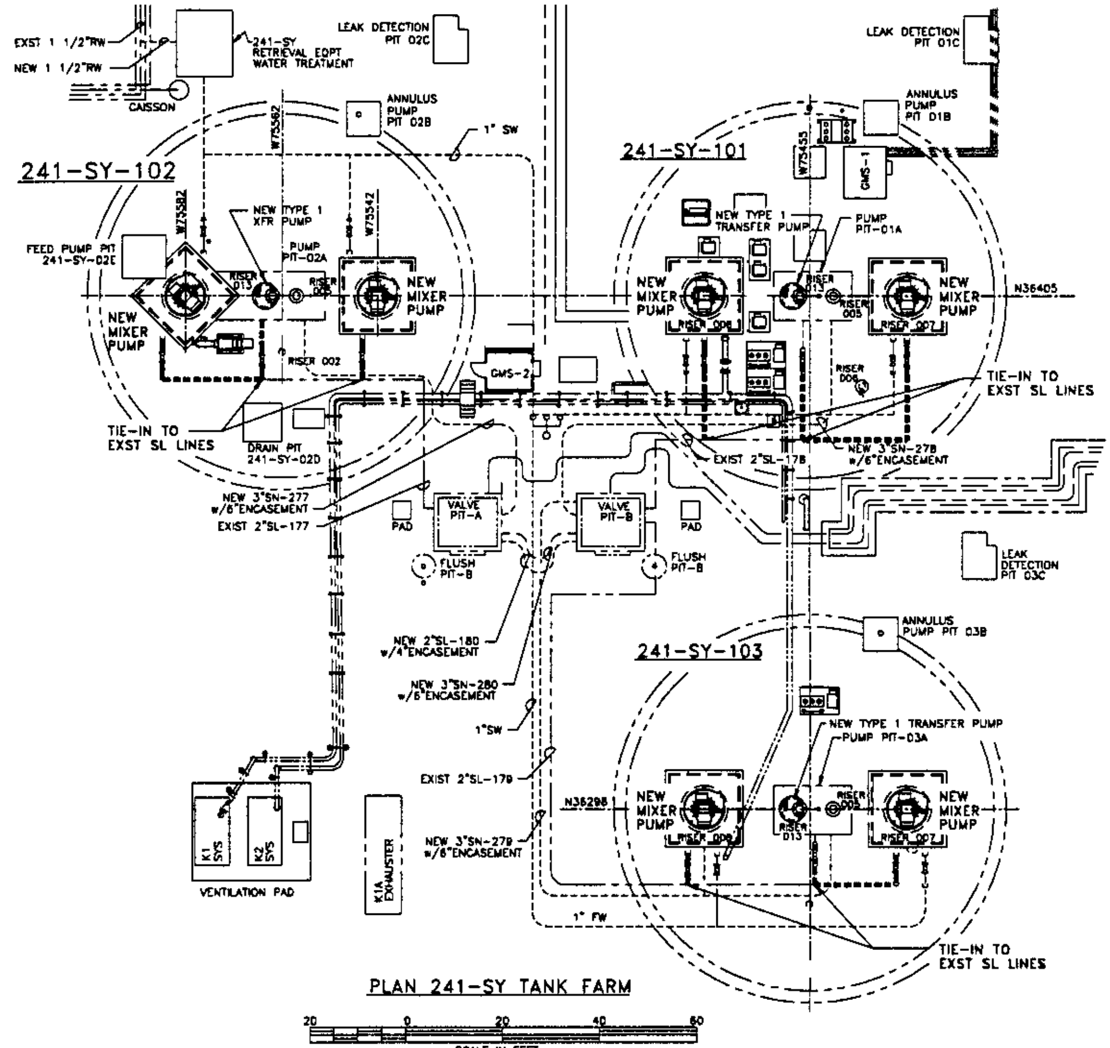


Figure 4-1. Tie-In to Existing Slurry Lines (CDR Basis).

The final option would be to provide a central hose connection station and use flexible hoses as required to feed the mixer pumps. The existing 3-in. service water line would be tied into just north of the 241-SY Valve Pits as shown in Figure 4-3. A single valve with a hose connection would be provided above grade. This option would require a flexible hose approximately 150-feet in length to reach the furthest mixer pump.

For either of the two options, the following drawings would require modification to reflect any changes to the CDR design:

- ESW-521-P6, Sheet 3, P&ID Waste Feed Delivery
- ESW-521-P7, Sheet 4, P&ID Caustic/Diluent Addn System 241-SY Tank Farm
- ESW-521-M6, Piping and Equipment Plan 241-SY Tank Farm
- ESW-521-ICD1, Sheet 3, Interface Control 241-SY

Finally, an estimate was prepared to determine the cost differences between the separate lines feeding the mixer pumps versus the single hose connection as compared with the CDR basis. The new service water lines option would have a reduction in cost to the CDR baseline of approximately $57,408 compared with tying into the existing slurry lines. The single hose station option would provide a reduction in cost to the CDR baseline of approximately $300,000 but is not recommended due to the reasons discussed in Section 5.0.

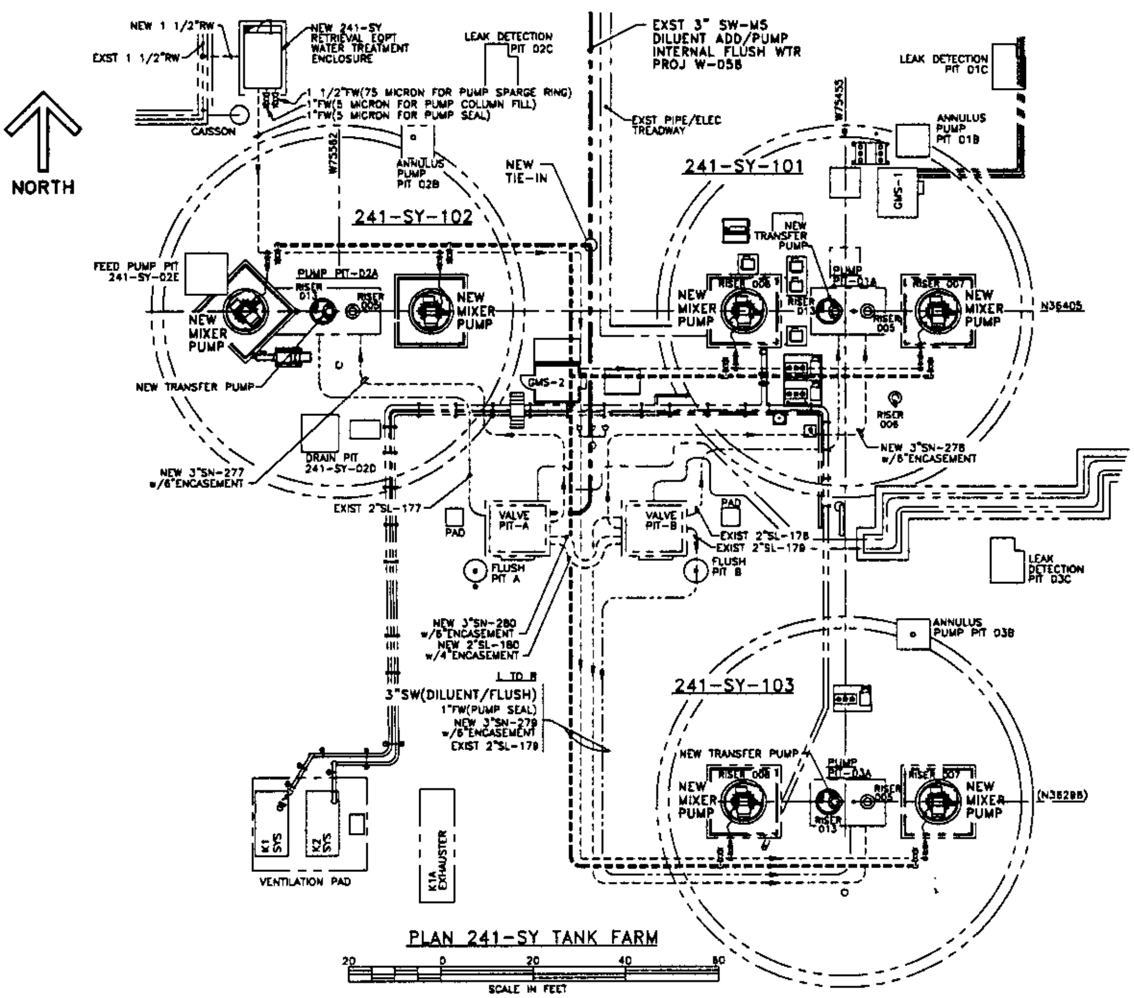


Figure 4-2. Separate Lines from Service Water Tie-In.

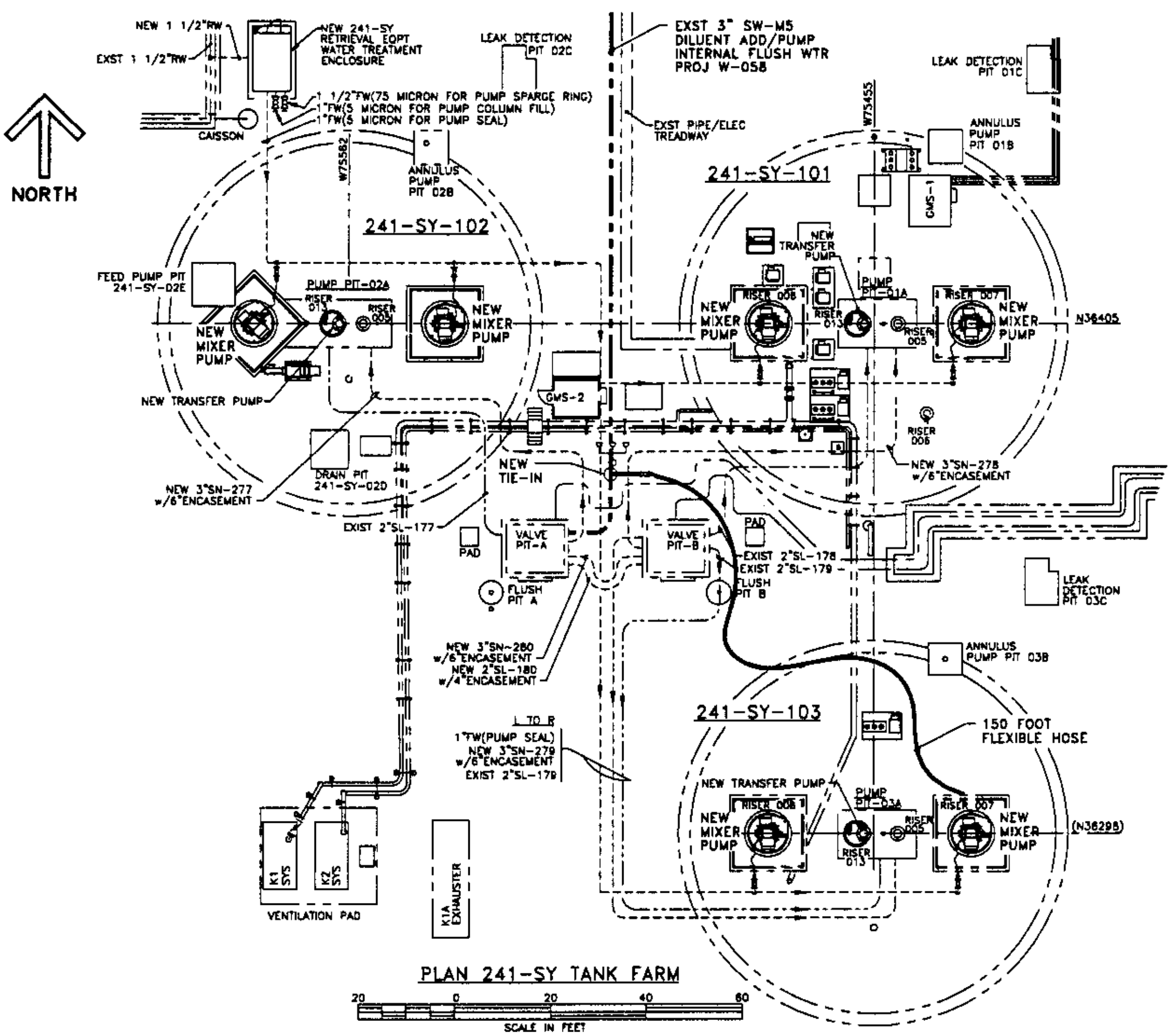


Figure 4-3. Hose Connection at Service Water Tie-in.

5.0 CONCLUSIONS AND RECOMMENDATIONS

As shown in the estimate analysis, the two options presented in this analysis would both be financially beneficial. Besides the cost savings, these options would provide a much more reliable system since the integrity of the existing slurry lines is not known and at flow rates of more than 19 feet/sec, the erosion rate of the piping would be greatly increased.

Although both options are acceptable, it is recommended that the separate line option by used over the single hose connection. The primary reason for this recommendation is that this option would provide less risk and cost to Operations over the life of the project. The single hose connection option would require the operators to drag a 100 plus foot hose around the tank farm that could interfere with other tank farm operations and would also increase the risk of a caustic/diluent spill. The cost reduction associated with the recommended option is summarized in Table 5.1.

Table 5-1. Cost

VALVING AND PIPING MODIFICATIONS (OPTION #1) - REDUCTION FROM CDR												
BASE COST	ODC'S	MU & CM	PM	DD	TITLE III	SU & OPS	EXP	STARTUP	SITE ALLOC	ESCAL	CONT	TOTAL
-$3,378	-$14,788	-$6,629	-$1,240	-$1,984	-$992	-$496	-$1,488	-$992	-$5,837	-$9,599	-$9,985	-$57,408

6.0 REFERENCES

Crane Technical Paper No. 410, *Flow of Fluids Through Valves, Fittings, and Pipe*, Crane Company, New York, New York.

HNF-4164, Rev. 0, *Double-Shell Tank Mixer Pump Subsystem Specification*, Cogema Engineering Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

W-521-SDD-03, Rev. 2, Draft, *Mixer Pump System Design Description*, ARES Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

Attachment Q

Attachment Q

Revised Cost Estimate

W-521 ACDR SUMMARY REPORT BY WBS (TRENDED ESTIMATE)

WBS	WBS DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	GRAND TOTAL
1.1	PROJECT MANAGEMENT	23,830,000	10%	2,380,000	26,210,000
1.2	ENGINEERING	48,150,000	21%	10,180,000	58,330,000
1.4	LONG LEAD EQUIPMENT	32,460,000	21%	6,840,000	39,300,000
1.5	CONSTRUCTION	133,430,000	23%	30,670,000	164,100,000
	TOTAL ESTIMATED COST (TEC)	**237,870,000**	**21%**	**50,070,000**	**287,940,000**
1.3	EXPENSE FUNDED PROJECT ACTIVITIES	22,960,000	11%	2,580,000	25,540,000
1.6	STARTUP / TURNOVER	12,430,000	19%	2,410,000	14,840,000
	OTHER PROJECT COSTS (OPC)	**35,390,000**	**14%**	**4,990,000**	**40,380,000**
	ADJUSTMENTS	40,000		40,000	80,000
	TOTAL PROJECT COST (TPC)	**273,300,000**	**20%**	**55,100,000**	**328,400,000**

REMARKS: The escalated total costs, contingency total costs, and the grand total costs are adjusted/rounded to the nearest $10,000. The Total Project Cost (TPC) is adjusted/rounded to the nearest $100,000

Hanford Site Allocations are included in the escalated total cost column.

This cost estimate includes the projected savings for the AY / AZ Primary Ventilation System which is currently pending CHG approval.

TYPE OF ESTIMATE: Advanced Conceptual	**Sept. 30, 2000**
HND TEAM LEAD ESTIMATOR:	
HND TEAM PROJECT MANAGER:	
CHG:	

W-[illegible]

ACDR ESTIMATE SUMMARY (TRENDED ESTIMATE)

WBS	WBS DESCRIPTION	ESTIMATE SUBTOTAL	SITE ALLOC	SUBTOTAL	ESCALATION	SUBTOTAL	CONTINGENCY	GRAND TOTAL
1.1	PROJECT MANAGEMENT	$19,188,593	$0	$19,188,593	$4,640,215	$23,828,808	$2,382,623	$26,211,431
1.2	ENGINEERING	$34,585,585	$6,225,401	$40,810,986	$7,338,705	$48,149,691	$10,184,565	$58,334,256
1.3	EXPENSE FUNDED ACTIVITIES	$19,362,912	$0	$19,362,912	$3,592,578	$22,955,490	$2,576,341	$25,531,831
1.4	LONG LEAD PROCUREMENT	$22,385,651	$4,029,339	$26,414,990	$6,045,469	$32,460,459	$6,841,252	$39,301,711
1.5	CONSTRUCTION	$92,700,320	$17,985,215	$110,685,535	$22,747,661	$133,433,196	$30,671,458	$164,104,654
1.6	STARTUP / TURNOVER	$9,940,080	$0	$9,940,080	$2,485,187	$12,425,267	$2,414,152	$14,839,419
		$198,163,141	$28,239,955	$226,403,096	$46,849,815	$273,252,911	$55,070,391	$328,323,302

Attachment R

Attachment R

Revised Drawings

SUMMARY OF DRAWING CHANGES

ITEM	DRAWING NUMBER	TASK NUMBER	DESCRIPTION OF CHANGE
1	ESW-521-C3, SH1	8	REFINED ROUTE, AND ADDED DETAIL BASED ON TRANSFER ROUTE SURVEY
2	ESW-521-C4, SH1	8	REFINED ROUTE, AND ADDED DETAIL BASED ON TRANSFER ROUTE SURVEY
3	ESW-521-C4, SH2	8	REFINED ROUTE, AND ADDED DETAIL BASED ON TRANSFER ROUTE SURVEY
4	ESW-521-C5, SH1	6,7,16	OPTIMIZED DILUENT PAD DESIGN, OPTIMIZED MIXER PUMP WATER DESIGN, OPTIMIZED DILUENT SYSTEM PIPING TIE-IN
5	ESW-521-C6, SH1	3,4	REMOVED LIFT STATION
6	ESW-521-C7, SH1	6,7,16	ADDED A WATER TREATMENT ENCLOSURE AND ENCLOSURE SLAB, DELETED 2 MIXER PUMPS FROM EACH TANK
7	ESW-521-C8, SH1	6	OPTIMIZED DILUENT PAD DESIGN,
8	ESW-521-S1, SH1	5,9	SWITCHGEAR SIZE INCREASED, MOVED POWER TRANSFER PANELS INTO ICE BUILDING
9	ESW-521-S2, SH1	8	ADDED DETAIL BASED ON THE SURVEY INFORMATION
10	ESW-521-S3, SH1	7	UPDATED VALVE PIT TABLE AS A RESULT OF REMOVING 2 MIXER PUMPS FROM EACH OF THE AY TANKS
11	ESW-521-P6, SH2	6	ADDED MOTOR OPERATED TANK MIXER SYMBOL
13	ESW-521-P6, SH3	2,7,9,14,16	UPDATED MIXER PUMP SYSTEM TABLE, ADDED NOTE 15 AS A RESULT OF THE MIXER PUMP FORCE STUDY, UPDATED CAMERA RISER TABLE, ADDED DILUENT TIE-IN
14	ESW-521-P6, SH4	1,9	UPDATED VALVE POSITION MATRIX, TRANSFER PUMP POWER REVISED
15	ESW-521-P6, SH5	2,9,16	UPDATED TEMPERATURE TREE TABLE, ADDED DILUENT TIE-IN, TRANSFER PUMP POWER REVISED
16	ESW-521-P7, SH1	7,13	OPTIMIZED MIXER PUMP WATER DESIGN, CHANGE TOTAL FLOW INDICATORS TO TOTAL FLOW TRANSMITTERS
17	ESW-521-P7, SH2	5,6,16	CHANGED FUEL FIRED BOILERS TO ELECTRIC HEATERS, REPLACED RECIRC PUMP WITH IN-TANK AGITATOR, REVISED PIPING TIE-INS
18	ESW-521-P7, SH3	7,13	OPTIMIZED MIXER PUMP WATER DESIGN, CHANGE TOTAL FLOW INDICATORS TO TOTAL FLOW TRANSMITTERS
19	ESW-521-P7, SH4	5,6,16	ADDED ELECTRIC HEATER AND ASSOCIATED INSTRUMENTATION, REPLACED RECIRC PUMP WITH IN-TANK AGITATOR, REVISED PIPING TIE-INS
21	ESW-521-P9, SH2	1	REFINED DESIGN TO INCLUDE DOUBLE ISOLATION
22	ESW-521-P10, SH1	1	REFINED DESIGN TO INCLUDE DOUBLE ISOLATION
23	ESW-521-P12, SH1	3	CHANGED CONDENSER CONDENSATE ROUTING TO NEW CONDENSATE SEAL POT
24	ESW-521-P13, SH1	3,4	REMOVED LIFT STATION, ADDED SEAL POT PUMP, AND REMOVED EXISTING 702 SEAL POT
25	ESW-521-M1, SH1	7	UPDATED MIXER PUMP AND TRANSFER PUMP TABLE, AY TANKS WILL HAVE 2 MIXER PUMPS INSTEAD OF 4
26	ESW-521-M1, SH2	-------	ADDED TANK LOCATION NOTE TO MIXER PUMP DETAILS FOR CLARIFICATION
27	ESW-521-M3, SH1	5,6,7,10,16	REVISED PLAN VIEW: REVISED DILUENT SYSTEM LAYOUT, ADDED WATER TREATMENT ENCLOSURE, REVISED CAMERA RISERS, REFINED DILUENT PIPING TIE-INS,
28	ESW-521-M4, SH1	2,3,6,7, 10, 16	REVISED PLAN VIEW BASED ON IMPINGEMENT FORCE EVALUATION, HVAC SCOPE REFINEMENTS, MIXER PUMP CHANGES, CAMERA RISER CHANGES, AND DILUENT PIPING TIE-IN CHANGES
29	ESW-521-M5, SH1	3,16	REVISED PLAN VIEW: ADDED ANNULUS VENT SKID, REMOVED LIFT STATION, CLEARLY DEFINED DILUENT TIE-INS

SUMMARY OF DRAWING CHANGES

30	ESW-521-M6, SH2	2, 7, 10, 16	CLEARLY DEFINED DILUENT TIE-INS, REVISED CAMERA RISERS, ADDED MIXER PUMP WATER SUPPLY, RELOCATED TEMPERATURE TREES BASED ON IMPINGEMENT FORCE
31	ESW-521-M7, SH1	1	REFINED DESIGN TO INCLUDE DOUBLE ISOLATION
32	ESW-521-M9, SH1	1	REFINED DESIGN TO INCLUDE DOUBLE ISOLATION
33	ESW-521-M12, SH1	5,6	REPLACED BOILER WITH ELECTRIC HEATERS, AND OPTIMIZED DILUENT PAD DESIGN
34	ESW-521-M13, SH1	3	REVISED NEW SEAL POT TO INCLUDE PUMP, REMOVED OLD SEAL POT,
35	ESW-521-M16, SH1	5,6	OPTIMIZED PAD DESIGN, ADDED ADDITIONAL ELECTRIC HEATER,
36	ESW-521-I&C1, SH1	5,13,14	*ADDED INSULATING CONCRETE AND TANK THERMOCOUPLES*, CHANGED TFLAN NOTE TO SHOW TFLAN BEING EXTENDED TO NEW ICE BUILDING FROM CLOSEST NODE, CHANGED BOILER CONTROL TO HEATER CONTROL
37	ESW-521-I&C1, SH2	3,7,13,14	CHANGED 4 MIXER PUMPS PER TANK TO 2 MIXER PUMPS PER TANK, ADDED INSULATING CONCRETE AND TANK THERMOCOUPLES, CHANGED TFLAN NOTE TO SHOW TFLAN BEING EXTENDED TO NEW ICE *BUILDING FROM CLOSEST NODE, ADD ANNULUS VENT PLCs FOR AY AND AZ AND CONNECT THEM TO THE* TFLAN
38	ESW-521-I&C1, SH3	5,13	CHANGED BOILER CONTROL TO HEATER CONTROL, CHANGED TFLAN NOTE TO SHOW TFLAN BEING EXTENDED TO NEW ICE BUILDING FROM THE CLOSEST NODE
39	ESW-521-E1, SH1	5	UPSIZED TRANSFORMER TO SUPPORT ELECTRIC HEATERS
40	ESW-521-E3, SH1	5,9	*REVISED ONE-LINE TO REFLECT POWER DISTRIBUTION PANELS AND UPSIZED SWITCHGEAR FOR DILUENT* HEATER
41	ESW-521-E4, SH1	7,9	REVISED ONE-LINE TO REFLECT POWER DISTRIBUTION PANELS, DELETED 2 MIXER PUMPS PER TANK
42	ESW-521-E5, SH1	3	REMOVED LIFT STATION PUMP
43	ESW-521-E6, SH1	9	REVISED MIXER PUMP POWER
44	ESW-521-E6, SH2	5	ADDED FLUSH TANK HEATER
45	ESW-521-E7, SH1	3	REMOVED THE LIFT STATION, ADDED ANNULUS VENT SKID
46	ESW-521-E7, SH2	3,7,9,10,16	ADDED ANNULUS VENT SKID, REMOVED 2 MIXER PUMPS FROM EACH TANK, REVISED MIXER PUMP POWER, CHANGED CAMERA RISERS,
47	ESW-521-E8, SH1	6,9,10, 16	CHANGED DRAWING AS A RESULT OF DILUENT PAD LAYOUT, REVISED MIXER PUMP POWER, CHANGED CAMERA RISERS, REVISED DILUENT SYSTEM PIPING TIE-INS
48	ESW-521-E9, SH1	6,9,10, 16	CHANGED DRAWING AS A RESULT OF DILUENT PAD LAYOUT, REVISED MIXER PUMP POWER, CHANGED CAMERA RISERS, REVISED DILUENT SYSTEM PIPING TIE-INS
49	ESW-521-E10, SH1	8	REVISED DRAWING BASED ON SURVEY OF TRANSFER ROUTE
50	ESW-521-ICD1, SH3	5	*CHANGED BOILER TO ELECTRIC HEATER*

PROJECT TITLE:

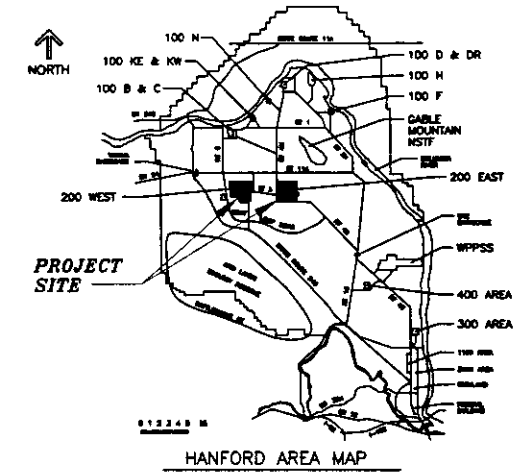
W-521 WASTE FEED DELIVERY SYSTEMS ACDR

FOR:

CH2M HILL HANFORD GROUP, INCORPORATED

BY:

HND TEAM



DRAWING LIST

CIVIL/STRUCTURAL

DRAWING NO.	TITLE
ESW-521-C1	DRAWING LIST & AREA MAP
* ESW-521-C2	KEY MAP 200 EAST
ESW-521-C3	SITE PLAN 241-AP TANK FARM
ESW-521-C4 SH 1	SITE PLAN TRANSFER LINES TO WTF
ESW-521-C4 SH 2	DETAILS
ESW-521-C5	PARTIAL SITE PLAN 241-AW TANK FARM
ESW-521-C6	VENTILATION PLAN 241-AY/AZ
ESW-521-C7	SITE PLAN 241-AY TANK FARM
ESW-521-C8	SITE PLAN 241-SY TANK FARM
ESW-521-S1	ICE BUILDING TYPICAL SECTIONS AND DETAILS
ESW-521-S2 SH 1	VALVE PIT PLAN & SECTION
* ESW-521-S2 SH 2	VALVE PIT SECTIONS & DETAILS
ESW-521-S3 SH 1	TYPICAL COVER BLOCK PLAN
* ESW-521-S3 SH 2	TYPICAL COVER BLOCK DETAILS
* ESW-521-S4	VENT CELL PLAN AND DETAILS

MECHANICAL

DRAWING NO.	TITLE
* ESW-521-P1	PFD 241-AW TANK FARM
* ESW-521-P2	PFD 241-AY TANK FARM
* ESW-521-P3	PFD 241-SY TANK FARM
ESW-521-P4	NOT USED
ESW-521-P5	NOT USED
* ESW-521-P6 SH 1	P&ID EQUIPMENT/INSTRUMENT NUMBER IDENTIFICATION
ESW-521-P6 SH 2	P&ID SYMBOL LEGEND
ESW-521-P6 SH 3	P&ID WASTE FEED DELIVERY
ESW-521-P6 SH 4	P&ID WASTE FEED DELIVERY
ESW-521-P6 SH 5	P&ID WASTE FEED DELIVERY
ESW-521-P7 SH 1	P&ID AW WATER TREATMENT RAW/FILTERED/SERVICE
ESW-521-P7 SH 2	P&ID AW WATER TREATMENT DILUENT/FLUSH
ESW-521-P7 SH 3	P&ID SY WATER TREATMENT RAW/FILTERED/SERVICE
ESW-521-P7 SH 4	P&ID SY WATER TREATMENT DILUENT/FLUSH
ESW-521-P7 SH 5	P&ID AY WATER TREATMENT RAW/FILTERED/SERVICE
* ESW-521-P8 SH 1	P&ID 241-SY-A & B VALVE PITS
* ESW-521-P9 SH 1	P&ID 241-AP-A VALVE PIT
ESW-521-P9 SH 2	P&ID 241-AP VALVE PIT
ESW-521-P10	P&ID 241-AW-02A PUMP PIT
* ESW-521-P11	P&ID PRIMARY TANK STACK MONITORING SYSTEM
ESW-521-P12	P&ID PRIMARY TANK VENT SYSTEM
ESW-521-P13	P&ID PRIMARY VENT CONDENSATE SYSTEM
* ESW-521-P14	P&ID PRIMARY VENT FILTRATION SYSTEM
* ESW-521-P15	P&ID VENT CONDENSATE SYSTEM
ESW-521-P16 SH 1	P&ID AY ANNULUS VENTILATION SYSTEM
ESW-521-P16 SH 2	P&ID AY ANNULUS VENTILATION SYSTEM
ESW-521-P17 SH 1	P&ID AZ ANNULUS VENTILATION SYSTEM
ESW-521-P17 SH 2	P&ID AZ ANNULUS VENTILATION SYSTEM

MECHANICAL (CONT'D)

DRAWING NO.	TITLE
ESW-521-M1 SH 1	W-521 TRANSFER AND MIXER PUMP ACTIVITY SCHEDULE
ESW-521-M1 SH 2	MIXER PUMP INSTALLATION
* ESW-521-M1 SH 3	TRANSFER PUMP INSTALLATION
ESW-521-M2	NOT USED
ESW-521-M3	PIPING AND EQUIPMENT PLAN 241-AW TANK FARM
ESW-521-M4	PIPING AND EQUIPMENT PLAN 241-AY TANK FARM
ESW-521-M5	PIPING AND EQUIPMENT PLAN 241-AZ TANK FARM
ESW-521-M6	PIPING AND EQUIPMENT PLAN 241-SY TANK FARM
ESW-521-M7	TRANSFER PUMP PIT PLAN 241-AW-01A/02A/03A/04A; -SY-01A/02A/03A
* ESW-521-M8	TRANSFER PUMP PIT PLAN 241-AY-01A, 241-AY-02A
ESW-521-M9	PLAN 241-AP VALVE PIT
* ESW-521-M10	PLAN 241-AP-A VALVE PIT
* ESW-521-M11	PLAN 241-SY-A & B VALVE PITS
ESW-521-M12	DILUENT/FLUSH SYSTEM PLAN 241-AW
ESW-521-M13	PLAN PRIMARY VENT CONDENSATE SYSTEM
* ESW-521-M14	296-A-42 PLAN – FIRST FLOOR PROCESS CONDENSATE LINE ADDITION
* ESW-521-M15	CHILLER SYSTEM PLAN
ESW-521-M16	CAUSTIC AND DILUENT SYSTEM PLAN 241-SY
ESW-521-M17	241-AY ANNULUS PLAN EXCAVATION
ESW-521-M18	ANNULUS SUPPLY AND EXHAUST PLAN 241-AY TANK FARM
ESW-521-M19	ANNULUS SUPPLY AND EXHAUST PLAN 241-AZ TANK FARM
ESW-521-M20	CAUSTIC AND DILUENT SYSTEM 241-SY DEMOLITION PLAN
ESW-521-M21	ANNULUS SUPPLY AND EXHAUST 241-AY DEMOLITION PLAN
ESW-521-M22	ANNULUS SUPPLY AND EXHAUST 241-AZ DEMOLITION PLAN

INSTRUMENTATION

DRAWING NO.	TITLE
ESW-521-I&C1 SH 1	RETRIEVAL CONTROL SYSTEM SY-101, SY-102, & SY-103 BLOCK DIAGRAM
ESW-521-I&C1 SH 2	RETRIEVAL CONTROL SYSTEM AY & AZ BLOCK DIAGRAM
ESW-521-I&C1 SH 3	RETRIEVAL CONT SYS AW-101, 102, 103, 104 & AP, AP-A VALVE PITS BLOCK DIAGRAM
* ESW-521-I&C2	LEAK DETECTION INTERFACE DETAILS
* ESW-521-I&C3	PLC/RELAY ENCLOSURE AND DETAILS
* ESW-521-I&C4	IN-TANK IMAGING SYSTEM
* ESW-521-I&C5	296-A-42 GAS MONITORING PLAN VIEW

* INDICATES DRAWINGS HAVE NOT BEEN MODIFIED AND ARE NOT INCLUDED IN THE ACDR PACKAGE

ELECTRICAL

DRAWING NO.	TITLE
ESW-521-E1	13.8 KV DISTRIBUTION LAYOUT/ONE LINE
* ESW-521-E2	NOT USED
ESW-521-E3	ONE LINE DIAGRAM 241-AW TANK FARM
ESW-521-E4	ONE LINE DIAGRAM 241-AY TANK FARM
ESW-521-E5	ONE LINE DIAGRAM 241-AZ-702 BUILDING
ESW-521-E6 SH 1	ONE LINE DIAGRAM 241-SY TANK FARM
ESW-521-E6 SH 2	ONE LINE DIAGRAM 241-SY TANK FARM
ESW-521-E7 SH 1	241-AY/AZ VENTILATION PLAN
ESW-521-E7 SH 2	PLAN 241-AY TANK FARM
ESW-521-E8	PLAN 241-AW TANK FARM
ESW-521-E9	PLAN 241-SY TANK FARM
ESW-521-E10	PLAN 241-AP TANK FARM
* ESW-521-E11	DETAILS
ESW-521-E12	ONE LINE DIAGRAM 241-AY ANNULUS
ESW-521-E13	ONE LINE DIAGRAM 241-AZ ANNULUS

INTERFACE CONTROL

DRAWING NO.	TITLE
* ESW-521-ICD1 SH 1	INTERFACE CONTROL 241-AY & 241-AZ
* ESW-521-ICD1 SH 2	INTERFACE CONTROL 241-AW & 241-AP
ESW-521-ICD1 SH 3	INTERFACE CONTROL 241-SY

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED TO SHOW EXISTING AND NEW SHEETS INCLUDED IN ACDR	KSH	KSH					

HND Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY

DRAWING LIST & AREA MAP

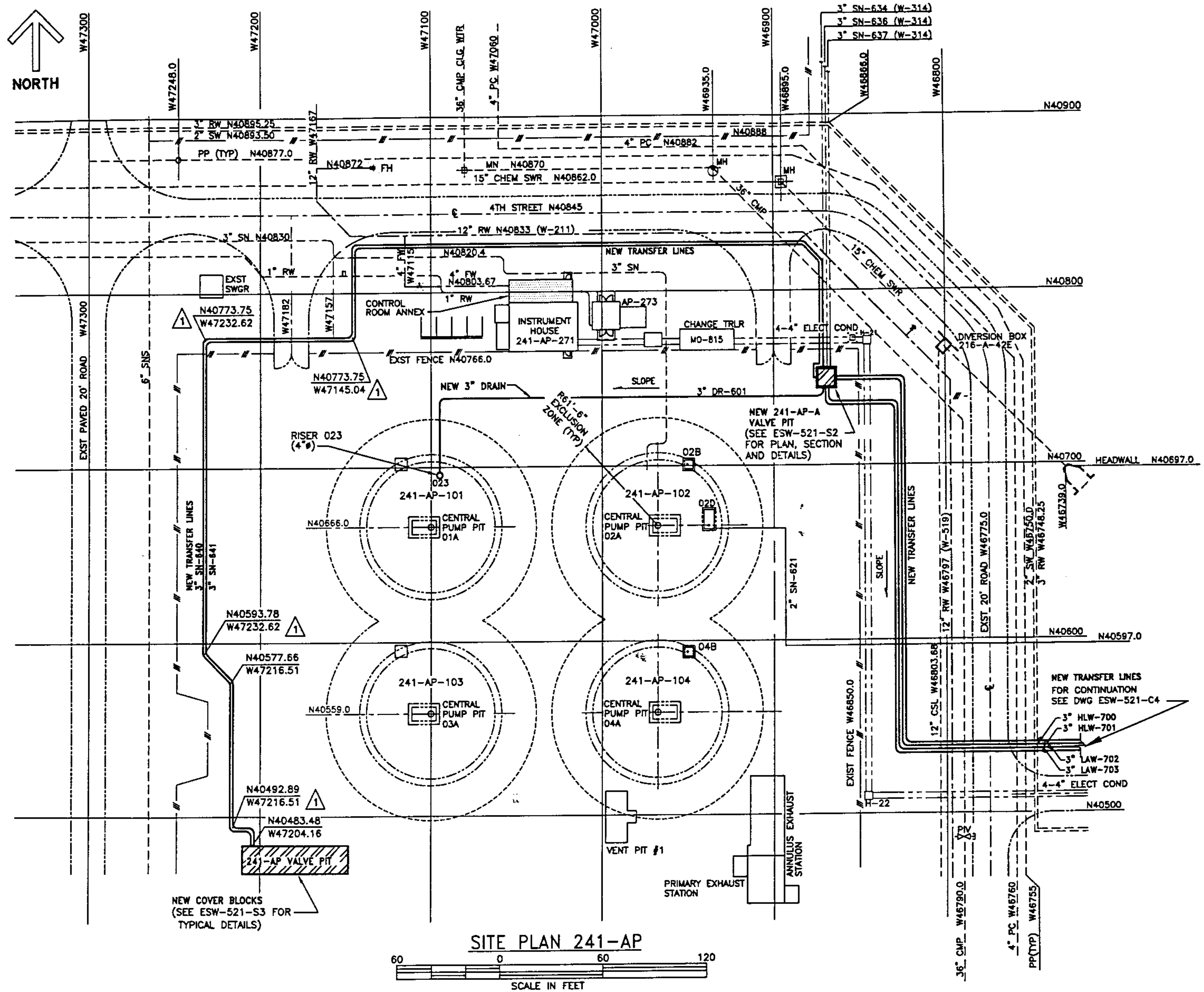
BLDG. 241-AP,-AW,-AY,-AZ &-SY

FOR
CH2M HILL HANFORD GROUP, INC.

DRAWN	RCC
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-C1	1



LEGEND

- PERIMETER FENCE
- EXISTING UNDERGROUND LINES
- W-211
- W-521

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   02050
   02200
   02235
   02512
   02831
   03300
   15493
2. WHERE EXISTING ROADWAYS ARE DISTURBED DURING INSTALLATION OF BURIED PIPE OR CONDUIT, REPAIR IAW OUTLINE SPECIFICATION SECTIONS 02235 AND 02512.
3. MINIMUM SLOPE SHALL BE $\frac{1}{16}$" PER FOOT.
4. APPLY SPECIAL PROTECTIVE COATING TO INSIDE OF EXISTING 241-AP VALVE PIT.

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.8 AND GENERAL MODIFICATION	KSH	KSH					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

CIVIL
SITE PLAN 241-AP TANK FARM

BLDG. 241-AP

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN	RC CROSKREY
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

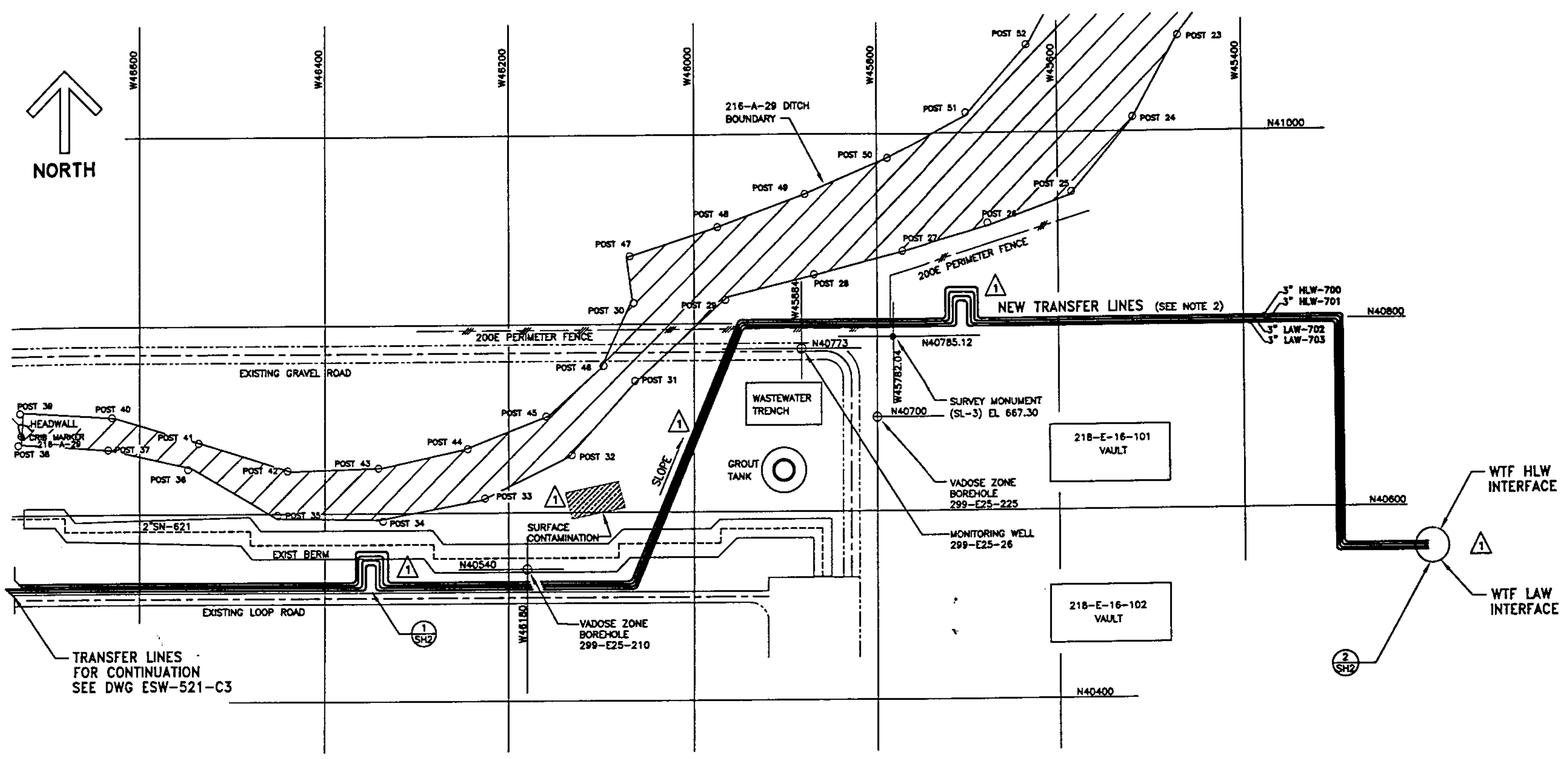
PROJECT ID 9909202.03 | DRAWING NO. ESW-521-C3 | REV. 1

LEGEND

- PERIMETER FENCE
- EXISTING UNDERGROUND LINES

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   02050
   02200
   02235
   02512
   02900
   03300
   15493
2. MINIMUM SLOPE SHALL BE 1/16" PER FOOT.



TRANSFER LINE PLAN

150 0 150 300
SCALE IN FEET

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.8	KSH	KSH					

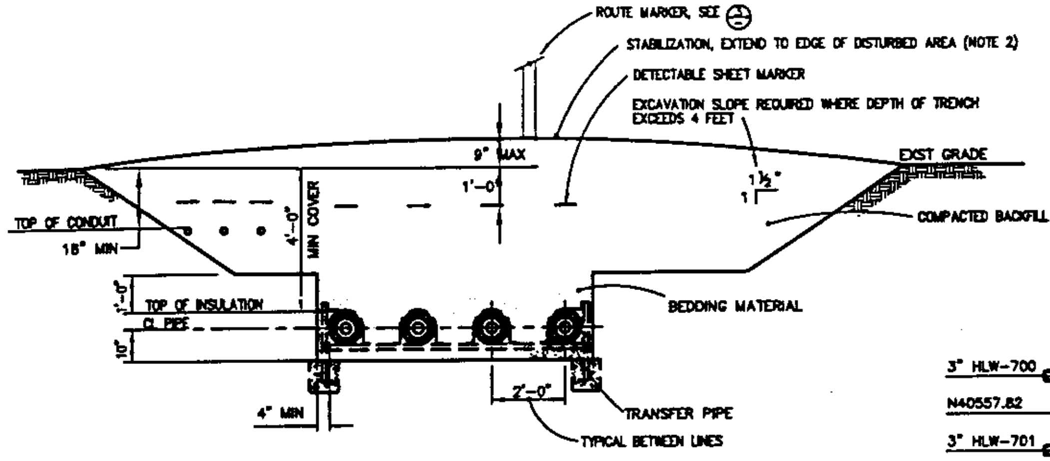
HNID Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
CIVIL
SITE PLAN
TRANSFER LINES TO WTF

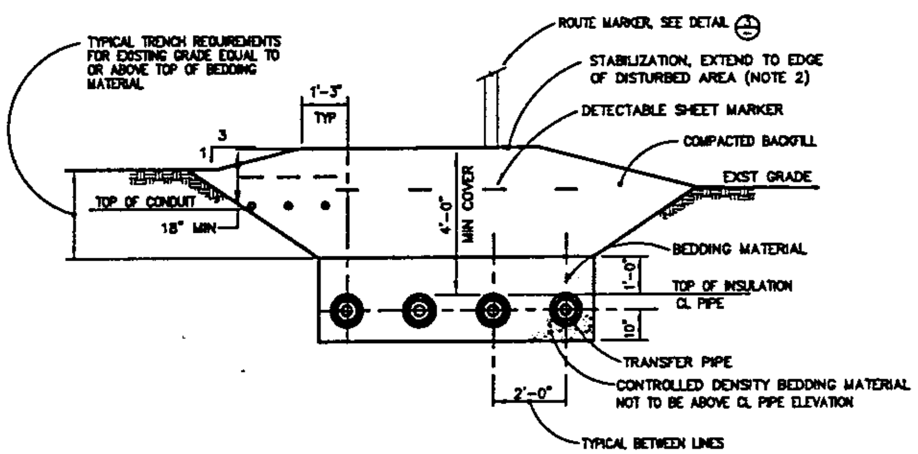
DRAWN	RC CROSKREY
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

BLDG. 241-AP
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 2

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-C4	1

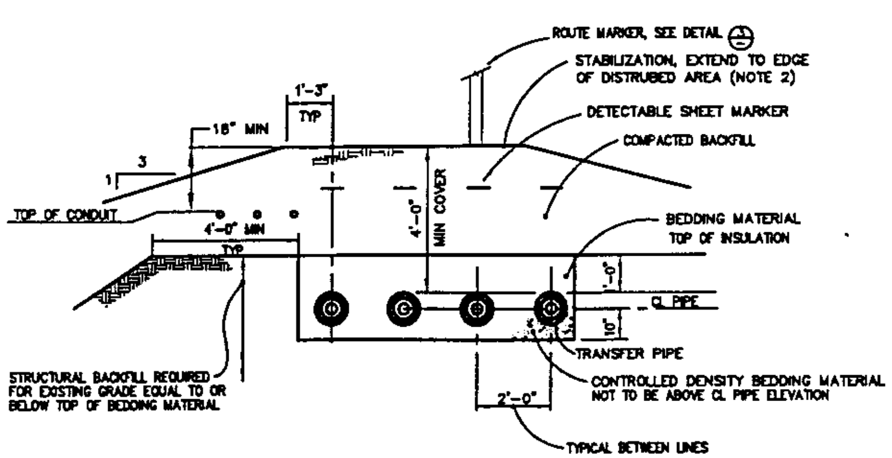


TYP TRENCH
SCALE: NONE

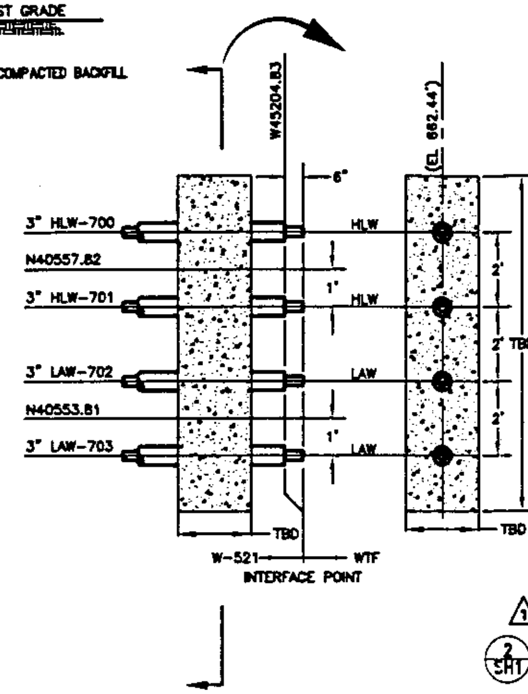


TYP BERM
SCALE: NONE

* FOR EXCEPTIONS SEE PLAN AND PROFILES WHERE NOTED



TYP BERM ON BACKFILL
SCALE: NONE



RPP/WTF INTERFACE
SCALE: NONE

DATUM TABLES AND NOTES:

1. LOCATIONS OF TIE-IN POINTS ARE IDENTIFIED IN THE HANFORD 200E PLANT COORDINATE SYSTEM. THE EQUIVALENT WASHINGTON STATE GRID AND WTF COORDINATES ARE GIVEN BELOW.

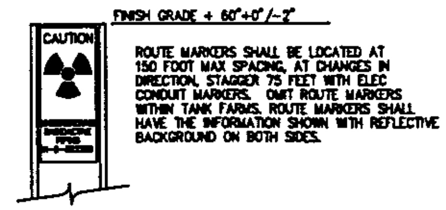
HORIZONTAL SURVEY DATUM

DESCRIPTION	HANFORD 200E PLANT COORDINATES (FEET)	WASHINGTON STATE GRID COORDINATES-WCS83S(1991) (METERS)	WTF COORDINATES (FEET)
HLW FEED INTERFACE	N40557.82 W45204.82	N135847.87 E576114.84	N4140 E9737
LAW FEED INTERFACE	N40553.81 W45204.83	N135846.65 E576114.84	N4136 E9737

2. THE ELEVATION OF THE TIE-IN POINT IS GIVEN IN THE HANFORD 200E VERTICAL DATUM. THE EQUIVALENT NAVD88 AND WTF ELEVATIONS ARE GIVEN BELOW:

DESCRIPTION	HANFORD 200E PLANT VERTICAL DATUM (FEET)	NAVD88 (METERS) (FEET)	WTF SYSTEM (FEET)
HLW/LAW FEED INTERFACE	662.44	203.00 666.00	666.00

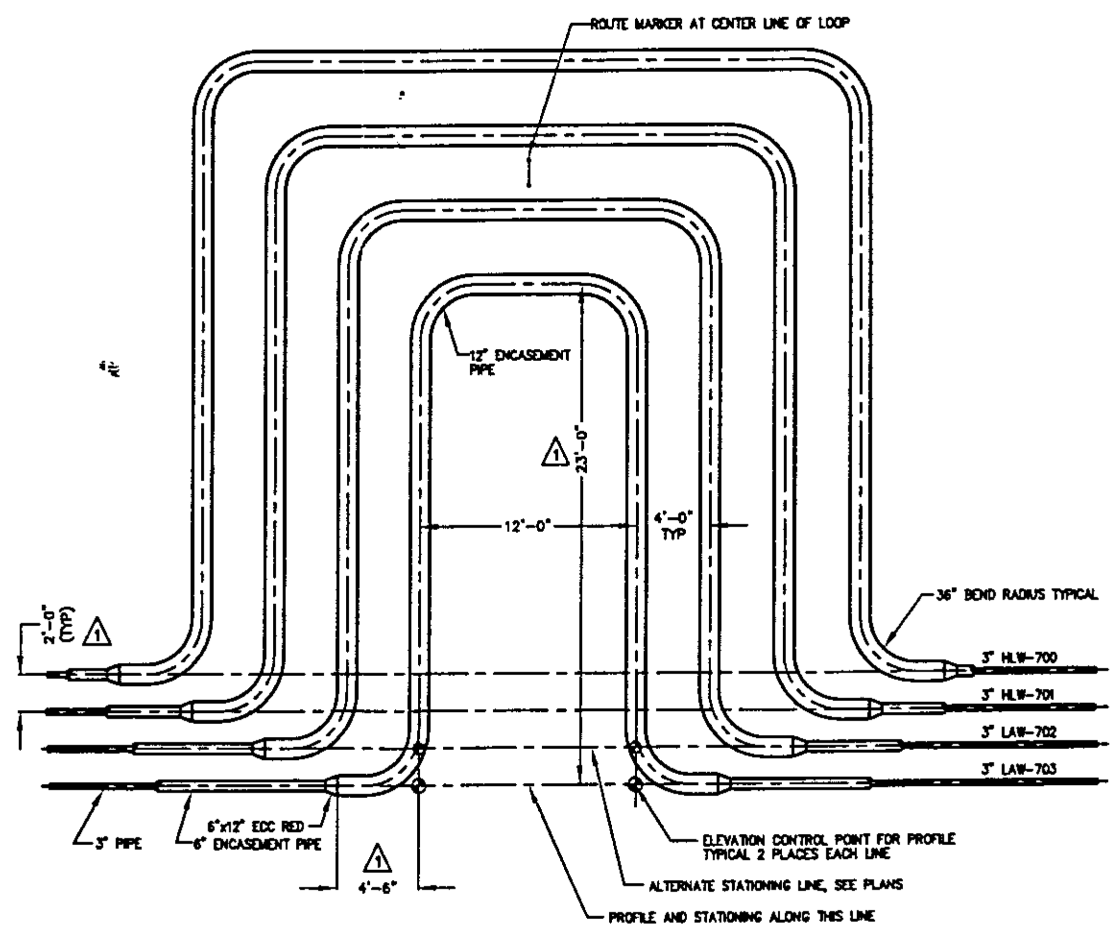
3. THE ANCHOR WILL BE SIZED TO ANCHOR LOADS TRANSMITTED FROM BOTH SIDES. NO LOADS WILL BE TRANSMITTED TO THE INTERFACE POINT FROM THE W-521 PIPING.



ROUTE MARKER
NTS

NOTES:

1. EACH ENCASED LINE REQUIRES THE FOLLOWING FEATURES:
   - PIPE ANCHORS
   - ENCASEMENT SUPPORTS
   - PIPE SUPPORTS
   - PIPE GUIDES AT EXPANSION LOOPS
2. STABILIZATION SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTIONS 02200 AND 02900 AS APPLICABLE.
3. HOLD - WTF INTERFACE COORDINATES CURRENTLY UNDER REVIEW FOR EXACT LOCATION. ANTICIPATED REMOVAL DATE 11-15-00.



PIPE INSULATION NOT SHOWN FOR CLARITY

EXPANSION LOOPS (2 REQD)
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.8 AND GENERAL MODIFICATION	KSH	KSH					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
CIVIL
DETAILS

DRAWN	J. DEVINE
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

BLDG. 200E, 200W

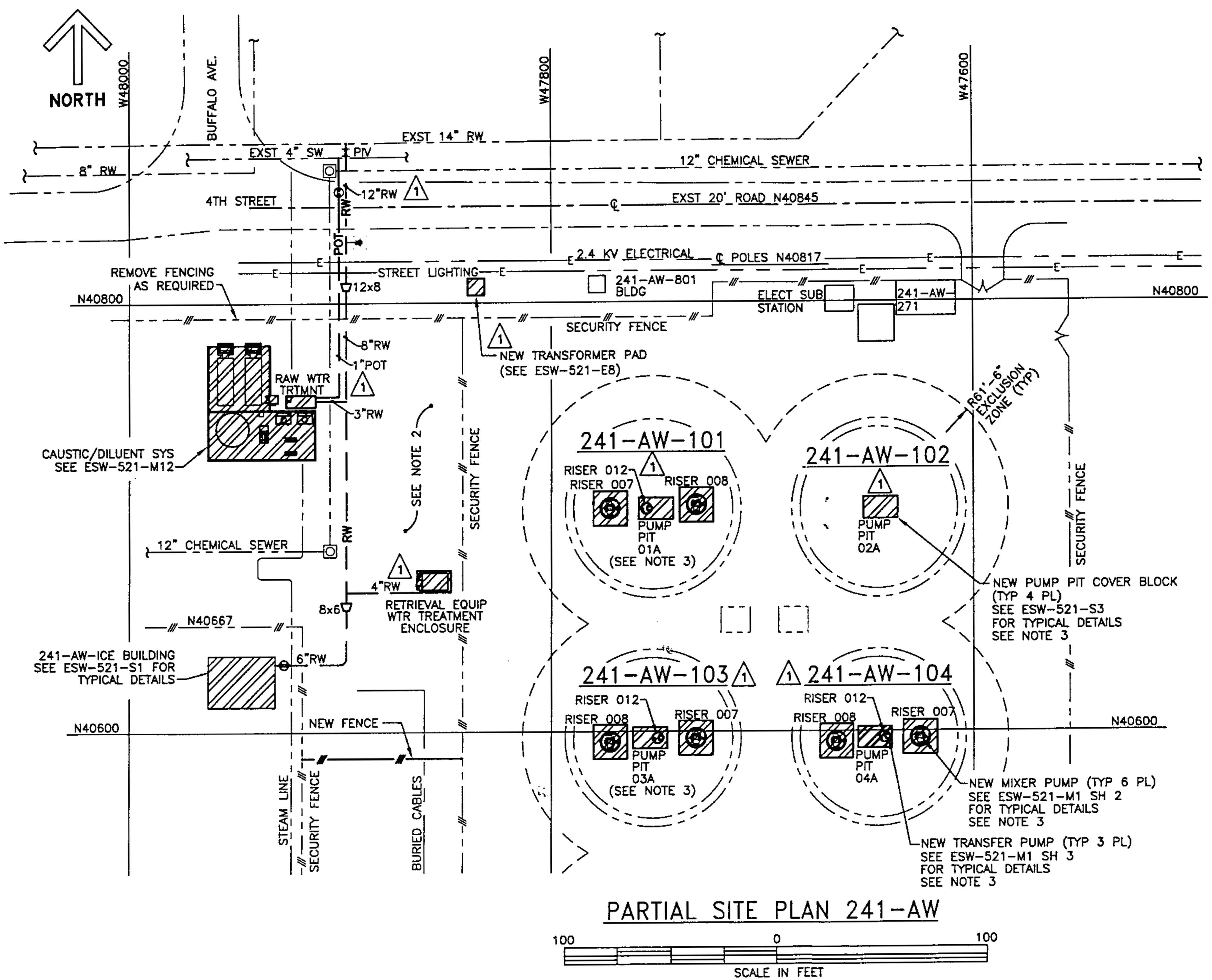
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 2 OF 2

PROJECT ID 9909202.03

DRAWING NO. ESW-521-C4

REV. 1



PARTIAL SITE PLAN 241-AW

LEGEND

- PERIMETER FENCE
- E — ELECTRICAL (OVERHEAD)
- EXISTING UNDERGROUND LINES
- RW — NEW RAW WATER
- POT — NEW POTABLE WATER
- FIRE HYDRANT
- PIV – POST INDICATOR VALVE
- W-521

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   02050
   02200
   02668
   02831
   03300
   09805
   13120
2. REMOVE SECURITY HARDWARE (MICROWAVE EQUIPMENT, ETC...) AS REQUIRED WITHIN OLD PUREX "EXCLUSION ZONE".
3. APPLY SPECIAL PROTECTIVE COATING TO INSIDE OF EXISTING PITS. SEE SPEC SECTION 09805.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPHS 4.6, 4.7, & 4.16	KSH	KSH					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
CIVIL
PARTIAL SITE PLAN
241-AW TANK FARM

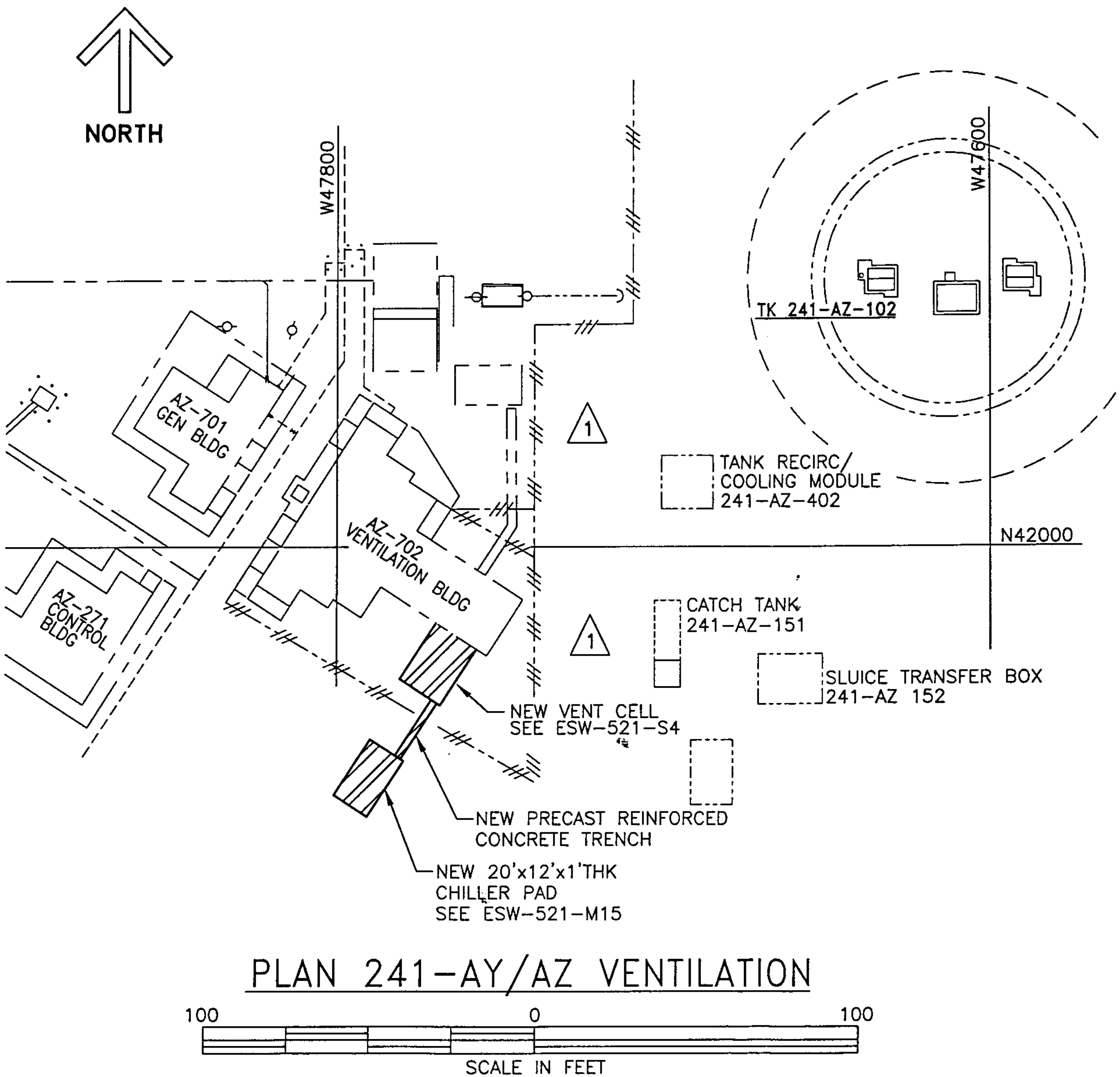
DRAWN	RC CROSKREY
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

BLDG. 241-AW

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-C5	1



PLAN 241-AY/AZ VENTILATION

LEGEND

- —//—//— PERIMETER FENCE
- — - — - — EXISTING
- – – – – – EXISTING UNDERGROUND LINES
- (hatched box) W-521

NOTE:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   02200
   03300
   03481
   09805

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.3 & 4.4	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

CIVIL
VENTILATION PLAN
241-AY/AZ

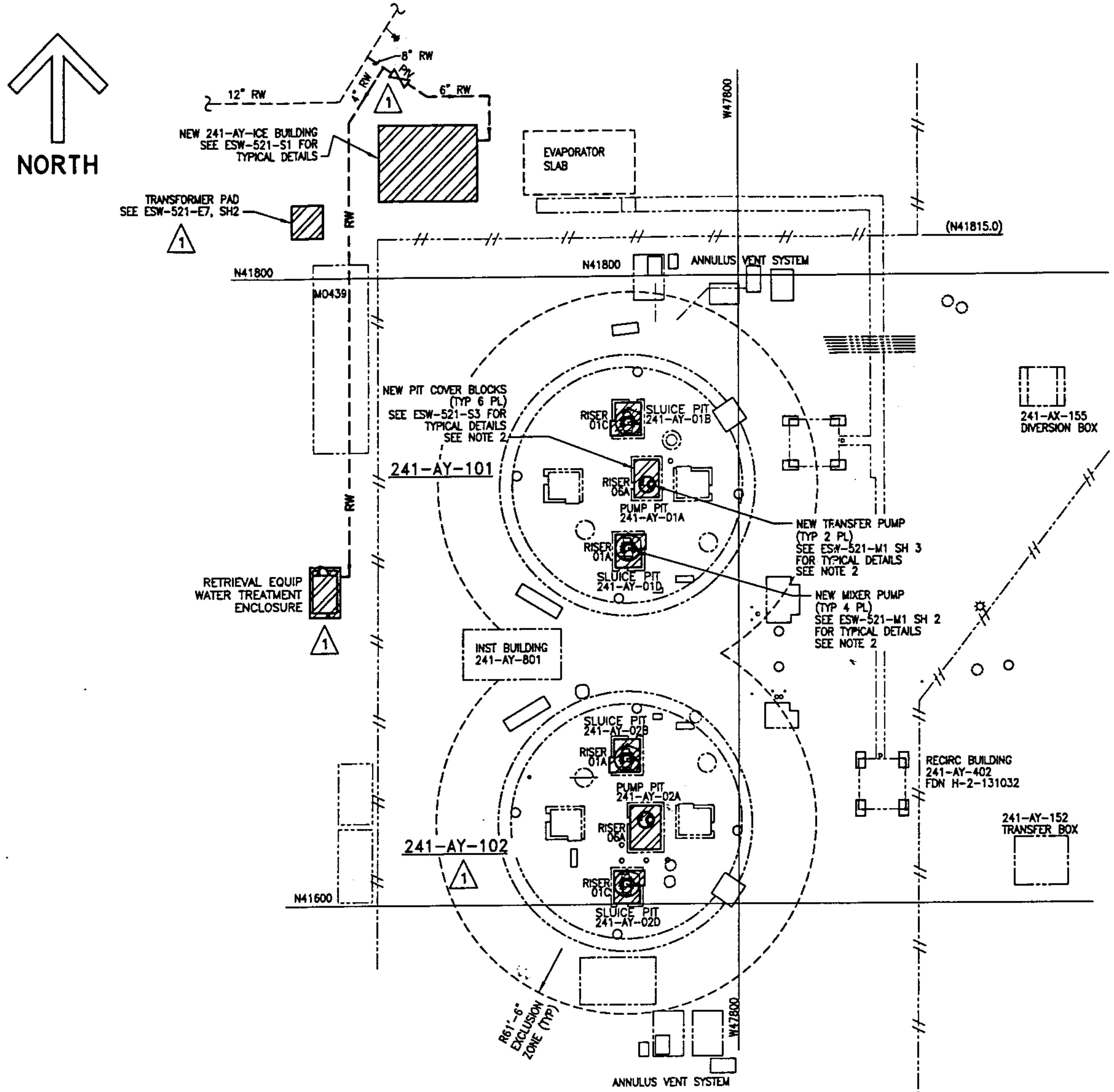
DRAWN	RC CROSKREY
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

BLDG. 241-AZ

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-C6	1



PLAN 241-AY TANK FARM

100 0 100
SCALE IN FEET

LEGEND

- —//— FENCE
- ——— EXISTING
- — RW — NEW RAW WATER
- (hatched) W-521

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   02050
   02200
   03300
   09805
2. APPLY SPECIAL PROTECTIVE COATING TO INSIDE OF EXISTING PITS. SEE SPEC SECTION 09805.

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.6, 4.7, & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

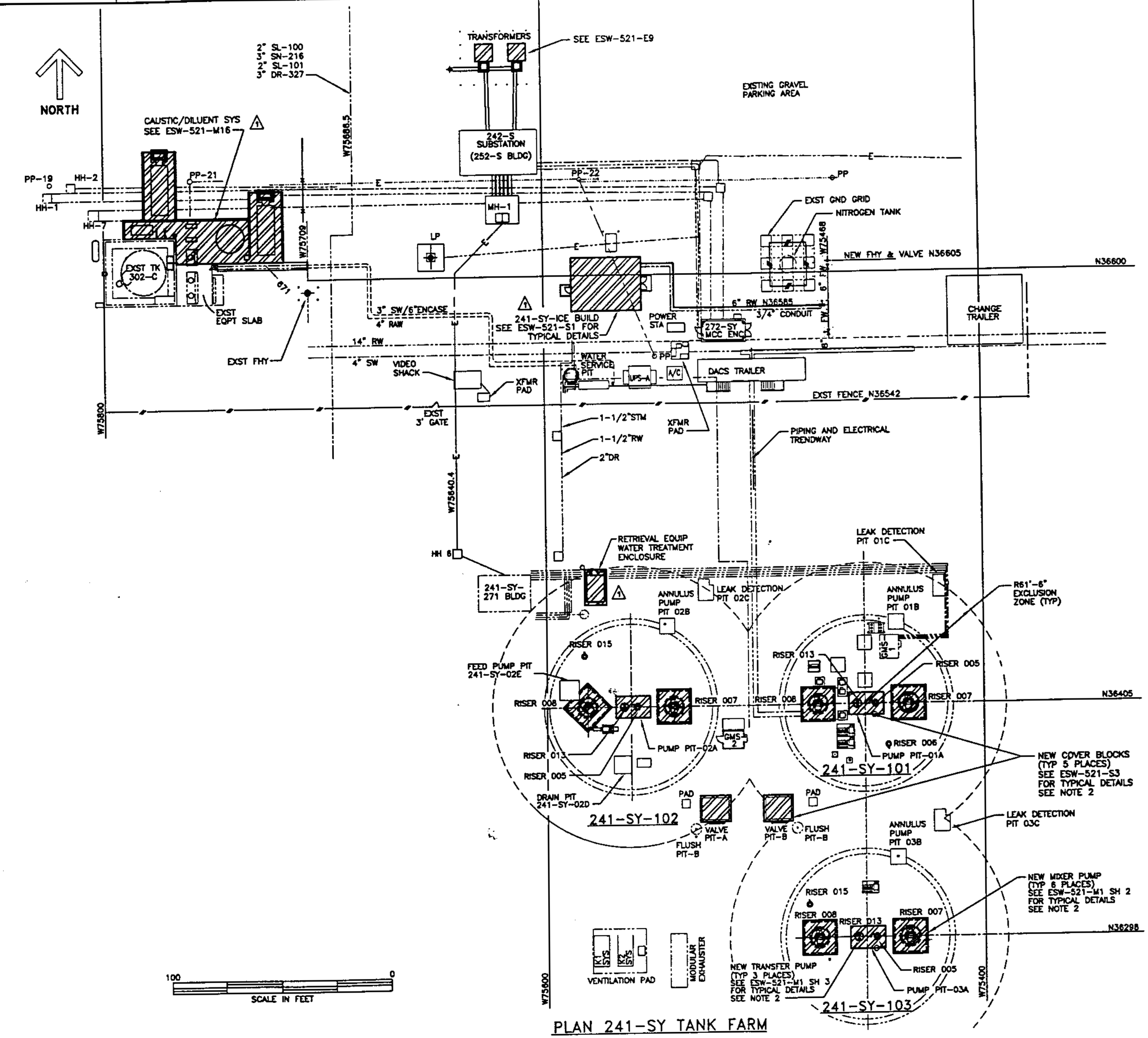
PROJECT W-521
WASTE FEED DELIVERY
CIVIL
SITE PLAN
241-AY TANK FARM

BLDG. 241-AY

DRAWN	RC CROSKREY
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

FOR CH2M HILL HANFORD GROUP, INC. — SHEET 1 OF 1

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-C7 — REV. 1



PLAN 241-SY TANK FARM

LEGEND

-------------	EXISTING
———————	NEW
(hatched)	W-521

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   02050
   02200
   03300
   09805
2. APPLY SPECIAL PROTECTIVE COATING TO INSIDE OF EXISTING PITS. SEE SPEC SECTION 09805.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.6	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

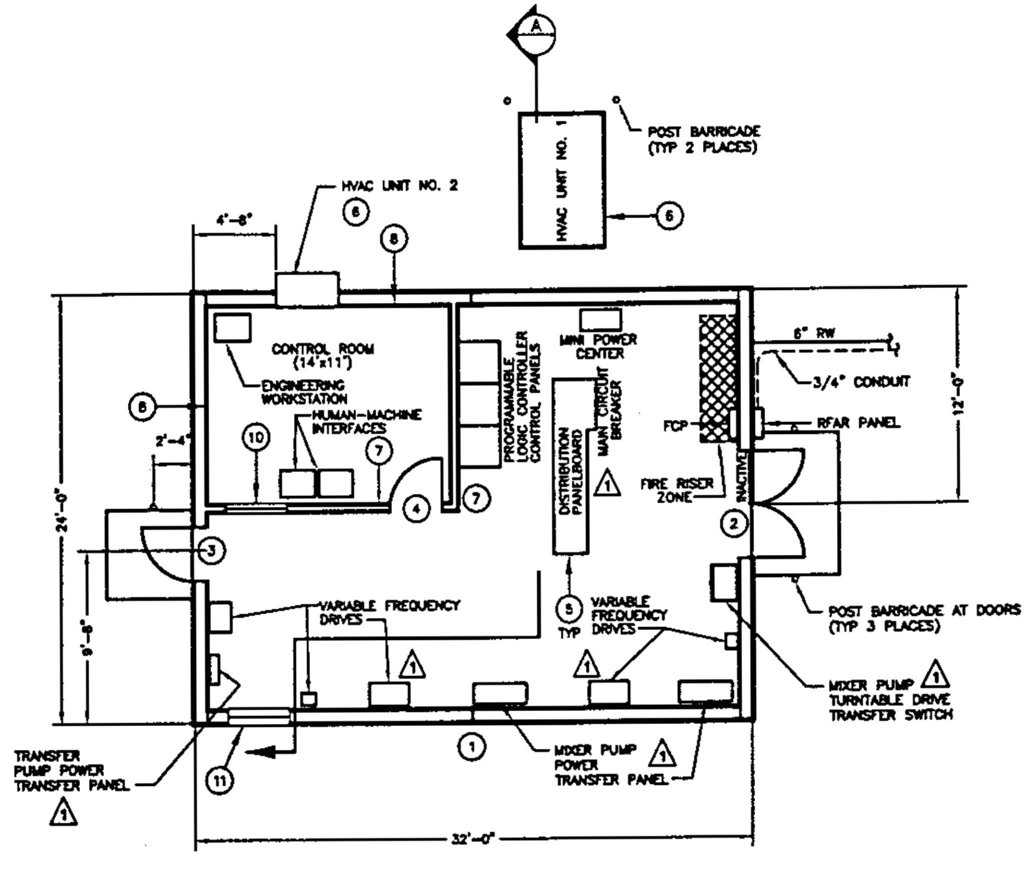
PROJECT W-521
WASTE FEED DELIVERY
CIVIL
SITE PLAN
241-SY TANK FARM

DRAWN	J. DEVINE
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

BLDG. 241-SY
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

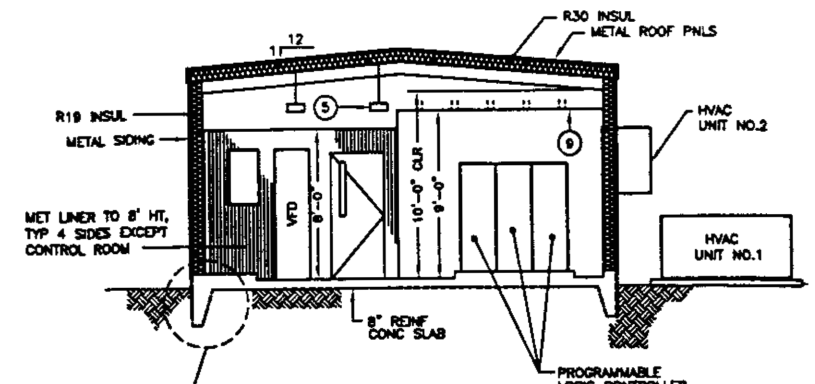
PROJECT ID 9909202.03 | DRAWING NO. ESW-521-C8 | REV. 1



241-AW-ICE
241-AY-ICE
241-SY-ICE

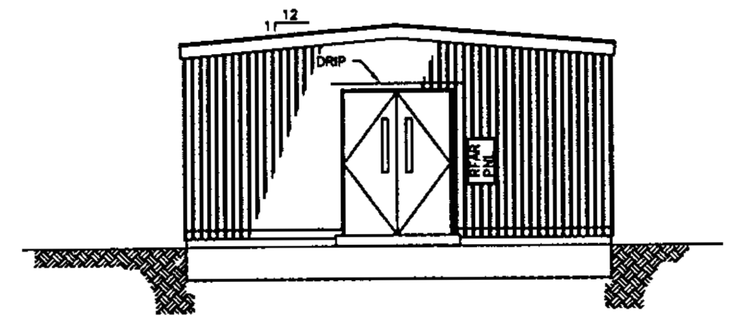
TYPICAL ICE BLDG FLOOR PLAN

SCALE: NONE



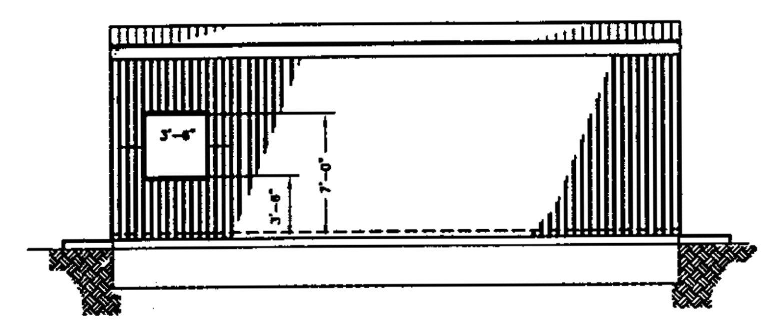
A SECTION

SCALE: NONE



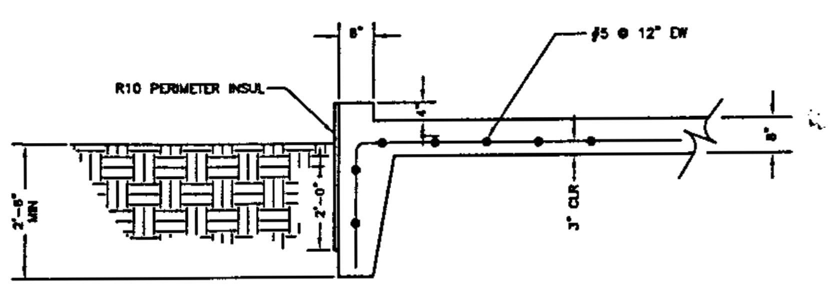
SIDE ELEVATION

SCALE: NONE



FRONT ELEVATION

SCALE: NONE



1 DETAIL

SCALE: NONE

NOTES:

1. PRE-ENGINEERED METAL BLDG
2. PAIR 3'-0"x8'-0"x1-3/4"x18 GA INSULATED STD STL DOORS
3. SINGLE 3'-0"x7'-0"x1-3/4"x18 GA INSULATED STD STL DOOR
4. SINGLE DOOR 3'-0" x 7'-0"x1-3/4"x18 GA STL DOOR
5. FOR ELEC EQUIPMENT, LIGHTING, EMBEDDED CONDUIT, DUCT BANK ROUTING, AND BLDG. GROUNDING, SEE OUTLINE SPEC SECTION 16400.
6. FOR HVAC EQUIPMENT, SEE OUTLINE SPECIFICATION SECTION 15500.
7. PARTITION CONSTRUCTION 3-1/2"x20 GA STEEL STUDS W/ 5/8" TYPE X GYPSUM WALLBOARD BOTH SIDES.
8. 3-1/2"x20 GA STEEL STUDS W/ 5/8" TYPE X GYPSUM WALLBOARD ONE SIDE.
9. 2' X 4' SUSPENDED ACOUSTICAL TILE CEILING.
10. 3'-6" X 3'-6" INTERIOR WINDOW.
11. 3'-6" X 3'-6" EXTERIOR WINDOW.
12. DESIGN PRE-ENGINEERED METAL BLDG (PEMB) IN ACCORDANCE WITH UBC AND OUTLINE SPECIFICATION SECTION 13120.
13. DESIGN CONCRETE FOUNDATION AND FLOOR IN ACCORDANCE WITH UBC AND ACI-318. FOUNDATION SHALL MEET PEMB MANUFACTURES REQUIREMENTS FOR ANCHOR BOLT LAYOUT AND LOADING. USE ALLOWABLE SOIL LOADS FROM UBC CHAPTER 18.
14. SEE OUTLINE SPECIFICATION SECTIONS:
02200 08710
03300 09900
05500 13120
07200 15300
07920 15500
08100 16400
12800
15. FOR INDIVIDUAL TANK FARM EQUIPMENT CONFIGURATION, SEE ONE-LINE DIAGRAMS ESW-521-E3, -E4, -E6.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5 & 4.9.	RJL	RJL					

HND Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

STRUCTURAL
ICE BUILDING
TYPICAL SECTIONS AND DETAILS

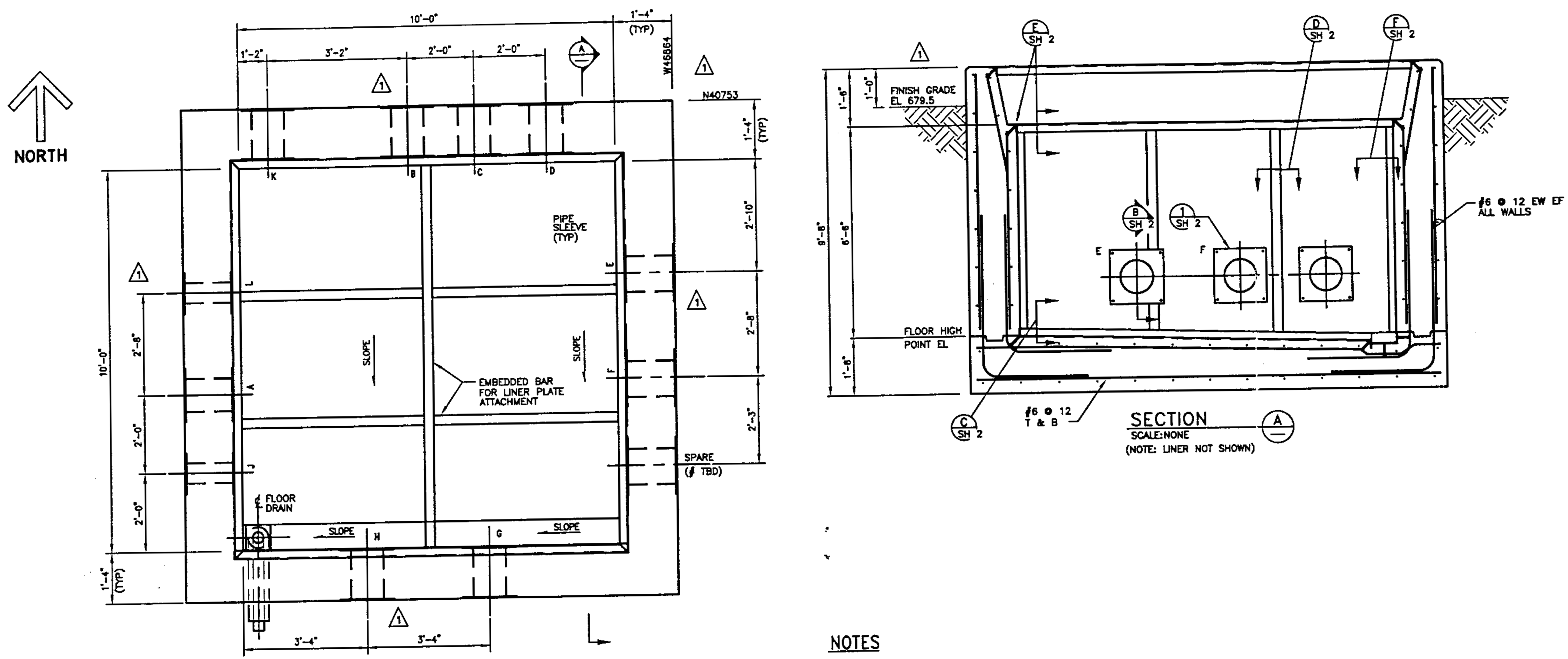
BLDG. 241-AW-ICE, 241-AY-ICE, 241-SY-ICE

DRAWN	RC CROSKREY
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

FOR
CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-S1	1



PLAN VIEW
NEW VALVE PIT 241-AP-A
SCALE: NONE
(NOTE: COVER BLOCKS AND LINER NOT SHOWN)

SECTION (A)
SCALE: NONE
(NOTE: LINER NOT SHOWN)

NOTES

1. DESIGN LOADS

LIVE:	COVER BLOCKS	200 PSF
SNOW/ASH:		20 PSF
SURCHARGE:		100 PSF
SOIL:		125 PSF
WIND:		ASCE 7, EXPOSURE CATEGORY C
PC3 SYSTEMS:	"FASTEST MILE" WIND VELOCITY	80 MPH
	"THREE SECOND GUST" WIND VELOCITY	100 MPH
PC1 SYSTEMS:	"FASTEST MILE" WIND VELOCITY	70 MPH
	"THREE SECOND GUST" WIND VELOCITY	85 MPH

SEISMIC:
PC1 STRUCTURES, SYSTEMS, AND COMPONENTS – UBC, SEISMIC ZONE 2B, STANDARD OCCUPANCY FACILITIES
PC3 STRUCTURES, SYSTEMS, AND COMPONENTS – DOE-STD-1020 AND LMH-PRO-097

SOIL BEARING PRESSURE: 2000 PSF

2. CONCRETE AND REINFORCING STEEL FOR THE PIT AND COVER BLOCKS ARE SAFETY CLASS (SC).
3. SEE OUTLINE SPECIFICATION SECTIONS: 02200, 03300, 05500, 05555, 09805
4. SEE ESW-521-S3 FOR COVER BLOCK DETAILS.

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

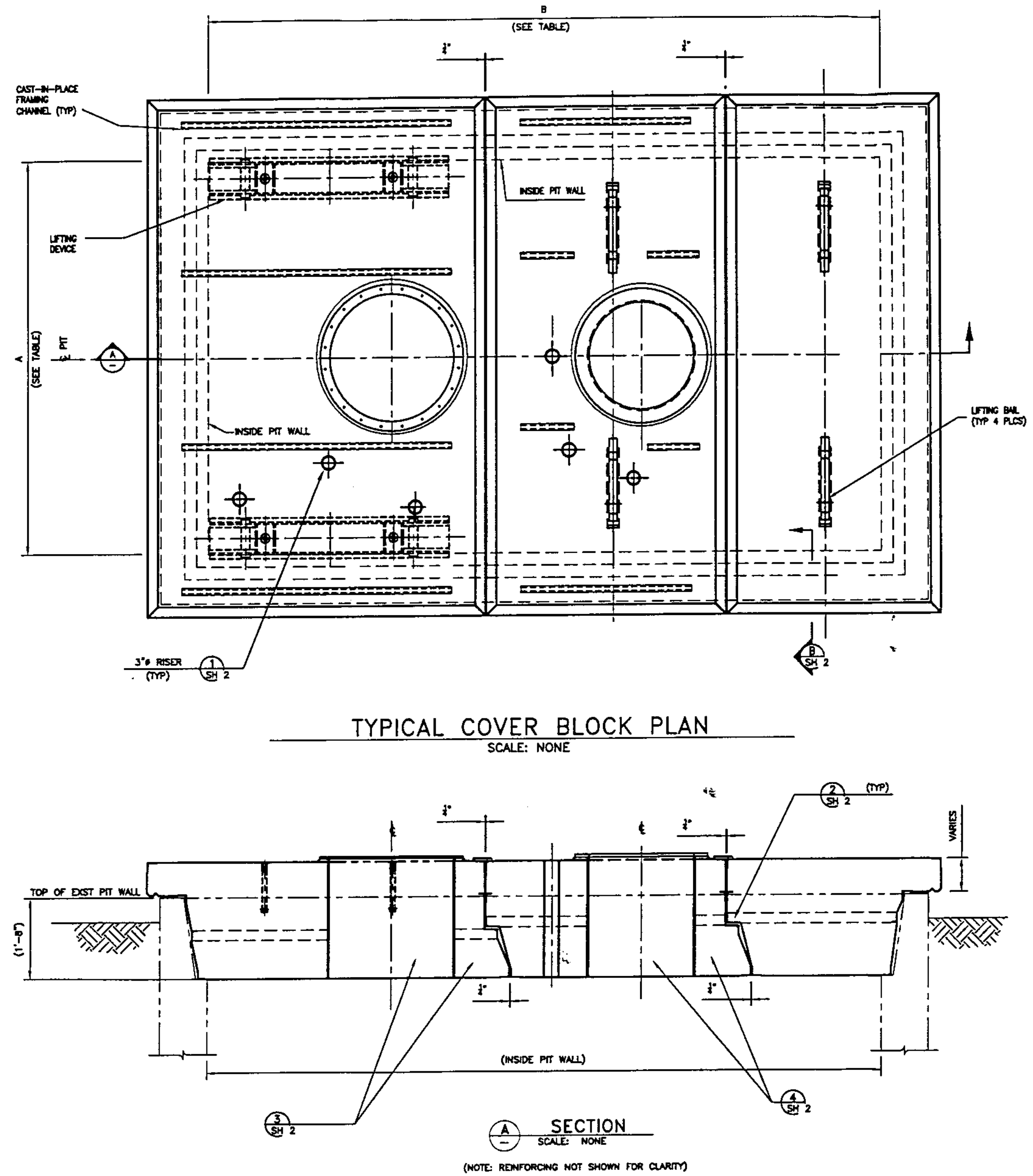
NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.8	RM	RM					

Holmes & Narver/DMJM | ARES CORPORATION | M&D

PROJECT W-521
WASTE FEED DELIVERY
STRUCTURAL
VALVE PIT PLAN & SECTION

DRAWN	J. DEVINE
DESIGN	C. CONSELMAN
CHECKED	
RELEASED	
DATE	

BLDG. 200-E, 200W
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 2
PROJECT ID 9909202.03
DRAWING NO. ESW-521-S2
REV. 1



TYPICAL COVER BLOCK PLAN
SCALE: NONE

A SECTION
SCALE: NONE

NOTES:

1. NEW COVER BLOCKS SHALL RECEIVE SPECIAL PROTECTIVE COATING. COAT ALL SURFACES.
2. PAINT COVER BLOCK LABELS AND GRAPHICS WITH SPECIAL PROTECTIVE COATING. SEE OUTLINE SPECIFICATION SECTION 09805.
3. GASKETS SHALL BE NEOPRENE (50±5 DUROMETER, ASTM D2000). BOND GASKETS TO COVER BLOCK EMBEDDED ANGLES & TO STEEL PLATES SHOWN WITH DOW CORNING 732 RTV SILICONE.
4. LOAD TEST COVER BLOCK LIFTING BAILS AT 125% OF ACTUAL COVER BLOCK WEIGHT BEFORE INSTALLATION/PLACEMENT OVER PIT.
5. CONCRETE & REINFORCING STEEL FOR THE COVER BLOCKS ARE SAFETY CLASS (SC).
6. SEE OUTLINE SPECIFICATION SECTIONS: 03300 05500 09805

PIT	INSIDE PIT WALL DIM. A X B (FT)	NUMBER OF COVER BLOCKS
241-AP VALVE PIT	16X41	8
241-AP-A VALVE PIT (NEW)	10X10	2
241-AW-01A PUMP PIT	8X14	3
241-AW-02A PUMP PIT	8X14	3
241-AW-03A PUMP PIT	8X14	3
241-AW-04A PUMP PIT	8X14	3
241-AY-01A PUMP PIT	8X12	3
241-AY-01B SLUICE PIT	6X8	2
241-AY-01D SLUICE PIT	6X8	2
241-AY-02A PUMP PIT	8X12	3
241-AY-02B SLUICE PIT	6X8	2
241-AY-02D SLUICE PIT	6X8	2
241-SY-A VALVE PIT	10X12	2
241-SY-B VALVE PIT	10X12	2
241-SY-01A PUMP PIT	8X14	3
241-SY-02A PUMP PIT	8X14	3
241-SY-03A PUMP PIT	8X14	3
241-AZ-702 VENT CELL	NA	2 (SEE ESW-521-S4)

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.7	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
STRUCTURAL
TYPICAL COVER BLOCK PLAN

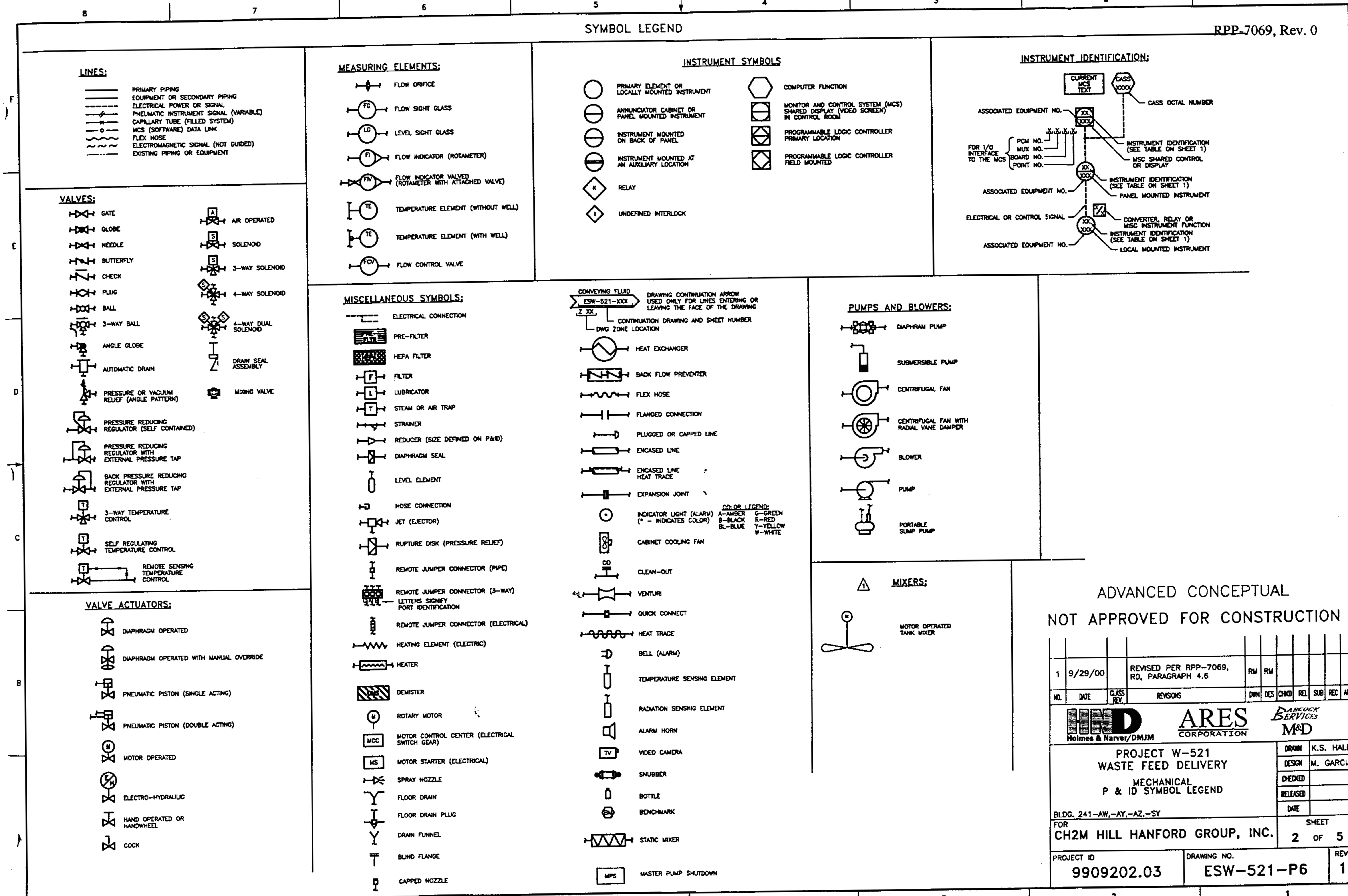
BLDG. 241-AP,-AW,-AY,-SY

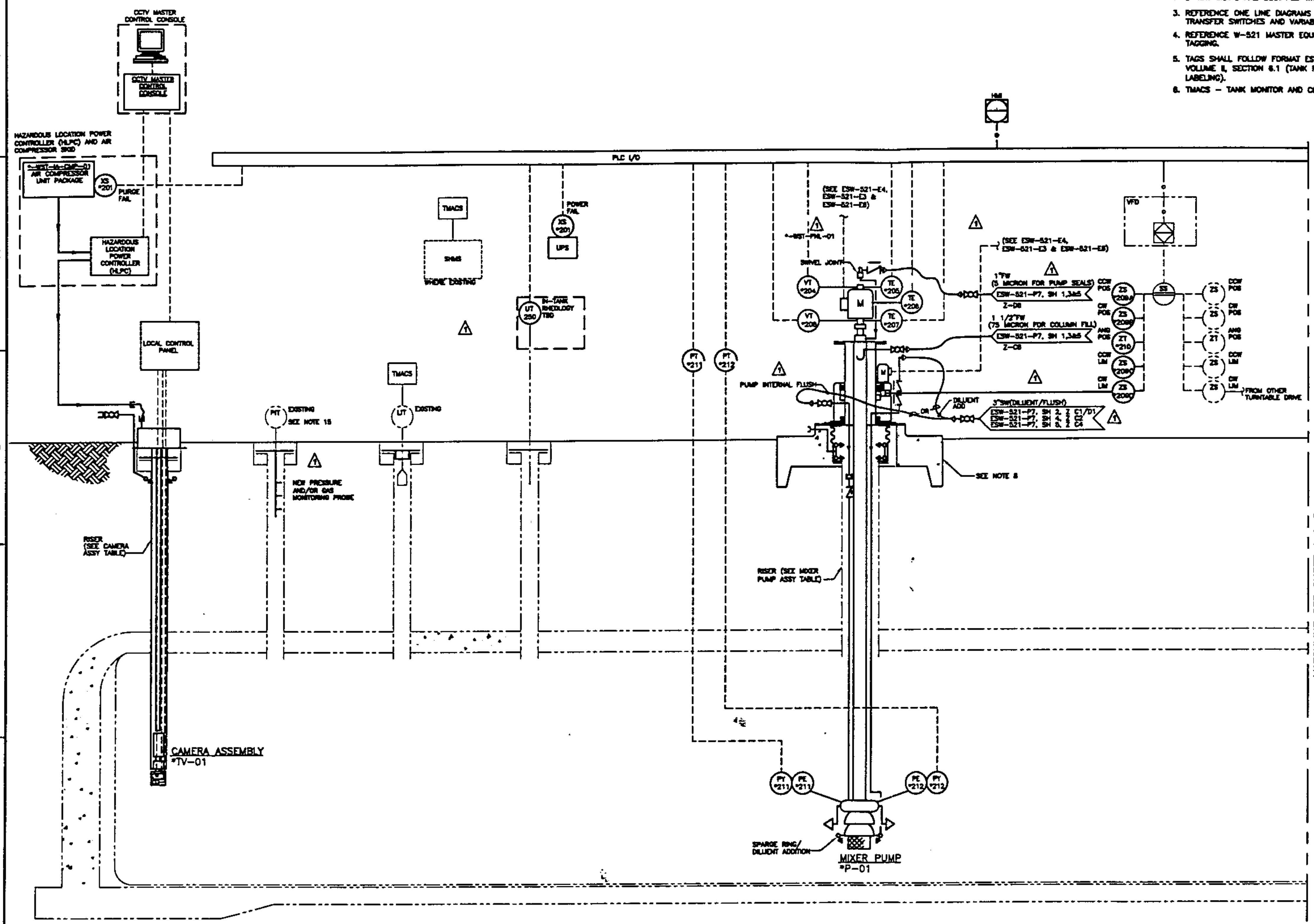
DRAWN K.S. HALE
DESIGN C. CONSELMAN
CHECKED
RELEASED
DATE

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 2

PROJECT ID 9909202.03
DRAWING NO. ESW-521-S3
REV. 1


SYMBOL LEGEND
LINES:
PRIMARY PIPING
EQUIPMENT OR SECONDARY PIPING
ELECTRICAL POWER OR SIGNAL
PNEUMATIC INSTRUMENT SIGNAL (VARIABLE)
CAPILLARY TUBE (FILLED SYSTEM)
MCS (SOFTWARE) DATA LINK
FLEX HOSE
ELECTROMAGNETIC SIGNAL (NOT GUIDED)
EXISTING PIPING OR EQUIPMENT
VALVES:
GATE
GLOBE
NEEDLE
BUTTERFLY
CHECK
PLUG
BALL
3-WAY BALL
ANGLE GLOBE
AUTOMATIC DRAIN
PRESSURE OR VACUUM RELIEF (ANGLE PATTERN)
PRESSURE REDUCING REGULATOR (SELF CONTAINED)
PRESSURE REDUCING REGULATOR WITH EXTERNAL PRESSURE TAP
BACK PRESSURE REDUCING REGULATOR WITH EXTERNAL PRESSURE TAP
3-WAY TEMPERATURE CONTROL
SELF REGULATING TEMPERATURE CONTROL
REMOTE SENSING TEMPERATURE CONTROL
AIR OPERATED
SOLENOID
3-WAY SOLENOID
4-WAY SOLENOID
4-WAY DUAL SOLENOID
DRAIN SEAL ASSEMBLY
MIXING VALVE
VALVE ACTUATORS:
DIAPHRAGM OPERATED
DIAPHRAGM OPERATED WITH MANUAL OVERRIDE
PNEUMATIC PISTON (SINGLE ACTING)
PNEUMATIC PISTON (DOUBLE ACTING)
MOTOR OPERATED
ELECTRO-HYDRAULIC
HAND OPERATED OR HANDWHEEL
COCK
MEASURING ELEMENTS:
FLOW ORIFICE
FLOW SIGHT GLASS
LEVEL SIGHT GLASS
FLOW INDICATOR (ROTAMETER)
FLOW INDICATOR VALVED (ROTAMETER WITH ATTACHED VALVE)
TEMPERATURE ELEMENT (WITHOUT WELL)
TEMPERATURE ELEMENT (WITH WELL)
FLOW CONTROL VALVE
MISCELLANEOUS SYMBOLS:
ELECTRICAL CONNECTION
PRE-FILTER
HEPA FILTER
FILTER
LUBRICATOR
STEAM OR AIR TRAP
STRAINER
REDUCER (SIZE DEFINED ON P&ID)
DIAPHRAGM SEAL
LEVEL ELEMENT
HOSE CONNECTION
JET (EJECTOR)
RUPTURE DISK (PRESSURE RELIEF)
REMOTE JUMPER CONNECTOR (PIPE)
REMOTE JUMPER CONNECTOR (3-WAY)
LETTERS SIGNIFY PORT IDENTIFICATION
REMOTE JUMPER CONNECTOR (ELECTRICAL)
HEATING ELEMENT (ELECTRIC)
HEATER
DEMISTER
ROTARY MOTOR
MOTOR CONTROL CENTER (ELECTRICAL SWITCH GEAR)
MOTOR STARTER (ELECTRICAL)
SPRAY NOZZLE
FLOOR DRAIN
FLOOR DRAIN PLUG
DRAIN FUNNEL
BLIND FLANGE
CAPPED NOZZLE
CONVEYING FLUID
ESW-521-XXX
Z XX
DRAWING CONTINUATION ARROW USED ONLY FOR LINES ENTERING OR LEAVING THE FACE OF THE DRAWING
CONTINUATION DRAWING AND SHEET NUMBER
DWG ZONE LOCATION
HEAT EXCHANGER
BACK FLOW PREVENTER
FLEX HOSE
FLANGED CONNECTION
PLUGGED OR CAPPED LINE
ENCASED LINE
ENCASED LINE HEAT TRACE
EXPANSION JOINT
INDICATOR LIGHT (ALARM) (* - INDICATES COLOR)
COLOR LEGEND:
A-AMBER G-GREEN
B-BLACK R-RED
BL-BLUE Y-YELLOW
W-WHITE
CABINET COOLING FAN
CLEAN-OUT
VENTURI
QUICK CONNECT
HEAT TRACE
BELL (ALARM)
TEMPERATURE SENSING ELEMENT
RADIATION SENSING ELEMENT
ALARM HORN
VIDEO CAMERA
SNUBBER
BOTTLE
BENCHMARK
STATIC MIXER
MASTER PUMP SHUTDOWN
INSTRUMENT SYMBOLS
PRIMARY ELEMENT OR LOCALLY MOUNTED INSTRUMENT
ANNUNCIATOR CABINET OR PANEL MOUNTED INSTRUMENT
INSTRUMENT MOUNTED ON BACK OF PANEL
INSTRUMENT MOUNTED AT AN AUXILIARY LOCATION
RELAY
UNDEFINED INTERLOCK
COMPUTER FUNCTION
MONITOR AND CONTROL SYSTEM (MCS) SHARED DISPLAY (VIDEO SCREEN) IN CONTROL ROOM
PROGRAMMABLE LOGIC CONTROLLER PRIMARY LOCATION
PROGRAMMABLE LOGIC CONTROLLER FIELD MOUNTED
INSTRUMENT IDENTIFICATION:
CURRENT MCS TEXT
CASS XXXX
CASS OCTAL NUMBER
ASSOCIATED EQUIPMENT NO.
FOR I/O INTERFACE TO THE MCS
PCM NO.
MUX NO.
BOARD NO.
POINT NO.
INSTRUMENT IDENTIFICATION (SEE TABLE ON SHEET 1)
MSC SHARED CONTROL OR DISPLAY
INSTRUMENT IDENTIFICATION (SEE TABLE ON SHEET 1)
PANEL MOUNTED INSTRUMENT
ELECTRICAL OR CONTROL SIGNAL
CONVERTER, RELAY OR MISC INSTRUMENT FUNCTION
INSTRUMENT IDENTIFICATION (SEE TABLE ON SHEET 1)
LOCAL MOUNTED INSTRUMENT
PUMPS AND BLOWERS:
DIAPHRAM PUMP
SUBMERSIBLE PUMP
CENTRIFUGAL FAN
CENTRIFUGAL FAN WITH RADIAL VANE DAMPER
BLOWER
PUMP
PORTABLE SUMP PUMP
MIXERS:
MOTOR OPERATED TANK MIXER
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
1 9/29/00 REVISED PER RPP-7069, R0, PARAGRAPH 4.6 RM RM
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
BABCOCK SERVICES M&D
PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P & ID SYMBOL LEGEND
BLDG. 241-AW,-AY,-AZ,-SY
FOR
CH2M HILL HANFORD GROUP, INC.
DRAWN K.S. HALE
DESIGN M. GARCIA
CHECKED
RELEASED
DATE
SHEET 2 OF 5
PROJECT ID 9909202.03
DRAWING NO. ESW-521-P6
REV. 1



NOTES:

1. 2-WAY MOV'S ARE EQUIPPED WITH (2) POSITION SWITCHES.
2. 3-WAY MOV'S ARE EQUIPPED WITH (3) POSITION SWITCHES.
3. REFERENCE ONE LINE DIAGRAMS FOR CONTINUATION OF TRANSFER SWITCHES AND VARIABLE SPEED DRIVES.
4. REFERENCE W-521 MASTER EQUIPMENT LIST FOR TANK SPECIFIC TAGGING.
5. TAGS SHALL FOLLOW FORMAT ESTABLISHED IN HNF-IP-0842, VOLUME II, SECTION 6.1 (TANK FARM OPERATIONS EQUIPMENT LABELING).
6. TMACS – TANK MONITOR AND CONTROL SYSTEM
7. RISERS SELECTED BASED ON THEIR CENTRAL LOCATION TO PROVIDE WIDEST FIELD OF VIEW TO ALL IN-TANK COMPONENTS. CAMERA INSTALLATION WILL MEET ALL CODES AND STANDARDS FOR PERMENANT INSTALLATION.
8. AY MIXER PUMPS ARE MOUNTED ON PIT COVER BLOCKS (SEE ESW-521-M1 SH 2)
9. EXISTING TEMPERATURE TREE ASSEMBLY DESIGN REQUIRES MINIMUM RISER DIAMETER OF 6 INCHES.
10. AW-103 TRANSFER PUMPS ARE NOT EQUIPPED WITH ADJUSTABLE SUCTION INDEXING.
11. NOT USED
12. MPS IS THE NEW MASTER PUMP SHUTDOWN SYSTEM COMPRISED OF REDUNDANT SAFETY SIGNIFICANT (SS) PROGRAMMABLE LOGIC CONTROLLERS (PLC'S) AND SINGLE GENERAL SERVICE (GS) PLC'S. SAFETY SIGNIFICANT INPUTS WILL BE HARD WIRED TO THE (SS) PLC'S.
13. PE, PSH-*214A,B ARE SAFETY SIGNIFICANT (SS).
14. TEMPERATURE TREES ARE SAFETY SIGNIFICANT (SS).
15. MITs WILL NOT WITHSTAND MIXER PUMP FORCES, AND THEREFORE WILL BE REMOVED. THE PRESSURE MEASUREMENT AND GAS MONITORING CAPABILITY AT SY-101 (RISER 018) WILL BE MAINTAINED. PRESSURE MEASUREMENT CAPABILITY WILL ALSO BE MAINTAINED AT SY-101 (RISER 019) AND SY-103 (RISER 018).

MIXER PUMP SYSTEMS
AW-101, -103, -104; AY-101, -102; SY-101, -102, -103

TAG	TANK	RISER	VFD
AW101-WST-P-01	AW-101	007	AW1CE-WST-VFD-01
AW101-WST-P-02	AW-101	008	AW1CE-WST-VFD-02
AW103-WST-P-01	AW-103	007	AW1CE-WST-VFD-01
AW103-WST-P-02	AW-103	008	AW1CE-WST-VFD-02
AW104-WST-P-01	AW-104	007	AW1CE-WST-VFD-01
AW104-WST-P-02	AW-104	008	AW1CE-WST-VFD-02
AY101-WST-P-01	AY-101	01A	AY1CE-WST-VFD-01
AY101-WST-P-02	AY-101	01C	AY1CE-WST-VFD-02
AY102-WST-P-01	AY-102	01A	AY1CE-WST-VFD-01
AY102-WST-P-02	AY-102	01C	AY1CE-WST-VFD-02
SY101-WST-P-01	SY-101	007	SY1CE-WST-VFD-01
SY101-WST-P-02	SY-101	008	SY1CE-WST-VFD-02
SY102-WST-P-01	SY-102	007	SY1CE-WST-VFD-01
SY102-WST-P-02	SY-102	008	SY1CE-WST-VFD-02
SY103-WST-P-01	SY-103	007	SY1CE-WST-VFD-01
SY103-WST-P-02	SY-103	008	SY1CE-WST-VFD-02

CAMERA ASSEMBLY
AW-101, -103, -104; AY-101, -102; SY-101, -102, -103

TAG	TANK	RISER	COMMENTS
AW101-WST-TV-01	AW-101	013	(SEE NOTE 7)
AW103-WST-TV-01	AW-103	013	(SEE NOTE 7)
AW104-WST-TV-01	AW-104	013	(SEE NOTE 7)
AY101-WST-TV-01	AY-101	22A	(SEE NOTE 7)
AY102-WST-TV-01	AY-102	22A	(SEE NOTE 7)
SY101-WST-TV-01	SY-101	014	(SEE NOTE 7)
SY102-WST-TV-01	SY-102	014	(SEE NOTE 7)
SY103-WST-TV-01	SY-103	014	(SEE NOTE 7)

TANK 241-AW-101;-103;-104
TANK 241-AY-101;-102
TANK 241-SY-101;-102;-103

* – REFERENCE HNF-IP-0842, VOLUME II, SECTION 6.1 (TANK FARM OPERATIONS EQUIPMENT LABELING). SEE MASTER EQUIPMENT LIST FOR TANK SPECIFIC INSTRUMENTATION TAGGING AND SAFETY CLASSIFICATION.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.2, 4.7, 4.9, 4.14, & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P & ID WASTE FEED DELIVERY

BLDG. 241-AW, -AY, -SY

FOR
CH2M HILL HANFORD GROUP, INC.

DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

SHEET 3 OF 5

PROJECT ID 9909202.03 | DRAWING NO. ESW-521-P6 | REV. 1

VALVE POSITION MATRIX

	OPERATION MODE	MOV-101	MOV-102	MOV-103	MOV-104	MOV-105
	RECIRCULATE WASTE	–	O	C	A	C
	TRANSFER WASTE 3" SN	–	O	C	B	B
**	IN-LINE DILUENT ADDITION	B	–	C	–	–
	IN-TANK DILUENT ADDITION	A	–	–	–	–
	FLUSH TRANSFER LINE	–	C	C	B	–
	DRAIN TRANSFER LINE	–	D	–	B	–
	FLUSH RECIRC LINE	–	C	–	C	–
	FLUSH PUMP (PURGE)	–	C	O	B	–

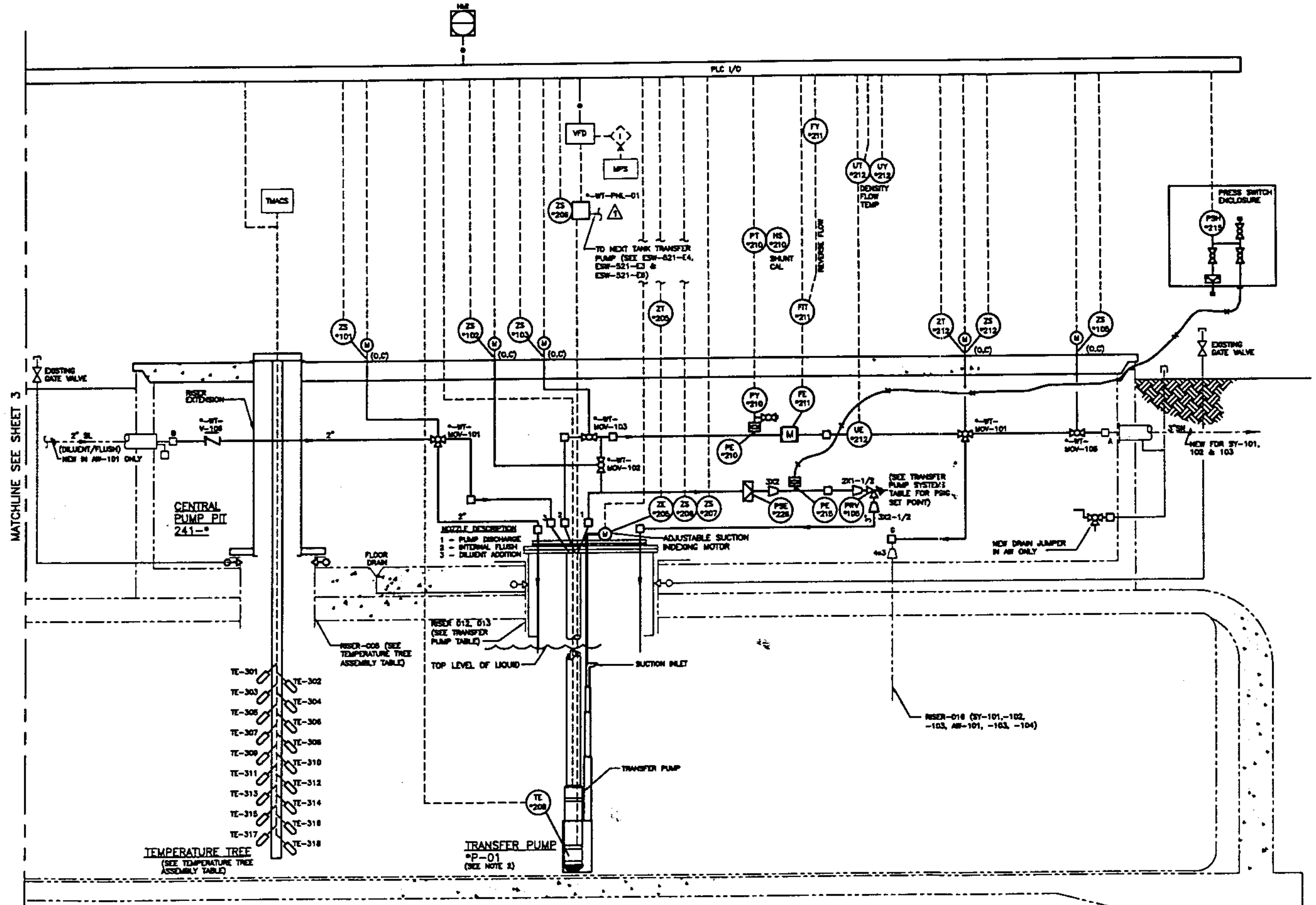
** – MAY COMPLETE THIS OPERATION IN CONJUCTION WITH WASTE RECIRCULATION AND WASTE TRANSFER

TRANSFER PUMP SYSTEMS
AW-101, -103, -104;
SY-101, -103

TAG	TANK	RISER	SHARED VFD	RELIEF VALVE SETTING	COMMENTS
AW01A-WT-P-01	AW-101	012	AWICE-WT-VFD-01	275 PSIG	
AW03A-WT-P-01	AW-103	012	AWICE-WT-VFD-01	275 PSIG	(SEE NOTE 13)
AW04A-WT-P-01	AW-104	012	AWICE-WT-VFD-01	275 PSIG	
SY01A-WT-P-01	SY-101	013	SYICE-WT-VFD-01	400 PSIG	
SY02A-WT-P-01	SY-102	013	SYICE-WT-VFD-01	400 PSIG	
SY03A-WT-P-01	SY-103	013	SYICE-WT-VFD-01	400 PSIG	

TEMPERATURE TREE ASSEMBLY
AW-101, -103, -104;
SY-101, -102, -103

TAG	TANK	RISER	COMMENTS
AW101-WST-TE-301 THRU 318	AW-101	005	(SEE NOTE 9)
AW103-WST-TE-301 THRU 318	AW-103	005	(SEE NOTE 9)
AW104-WST-TE-301 THRU 318	AW-104	005	(SEE NOTE 9)
SY101-WST-TE-301 THRU 318	SY-101	005	(SEE NOTE 9)
SY102-WST-TE-301 THRU 318	SY-102	005	(SEE NOTE 9)
SY103-WST-TE-301 THRU 318	SY-103	005	(SEE NOTE 9)



TANK 241-AW-101;-103;-104
TANK 241-SY-101;-102;-103

* – REFERENCE HNF-IP-0842, VOLUME II, SECTION 6.1 (TANK FARM OPERATIONS EQUIPMENT LABELING). SEE MASTER EQUIPMENT LIST FOR TANK SPECIFIC INSTRUMENTATION TAGGING AND SAFETY CLASSIFICATION.

NOTE:

1. SEE SHEET 1 AND 2 FOR EQUIPMENT IDENTIFICATION NAMING LEGEND AND SYMBOLS. SEE SHEET 3 FOR NOTES.
2. TRANSFER PUMP TYPE SHOWN IS REPRESENTATIVE. SEE SHEET M-1 FOR ACTUAL PUMP TYPE.

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.1 & 4.9	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P & ID WASTE FEED DELIVERY

BLDG. 241-AW, -SY,
FOR CH2M HILL HANFORD GROUP, INC.

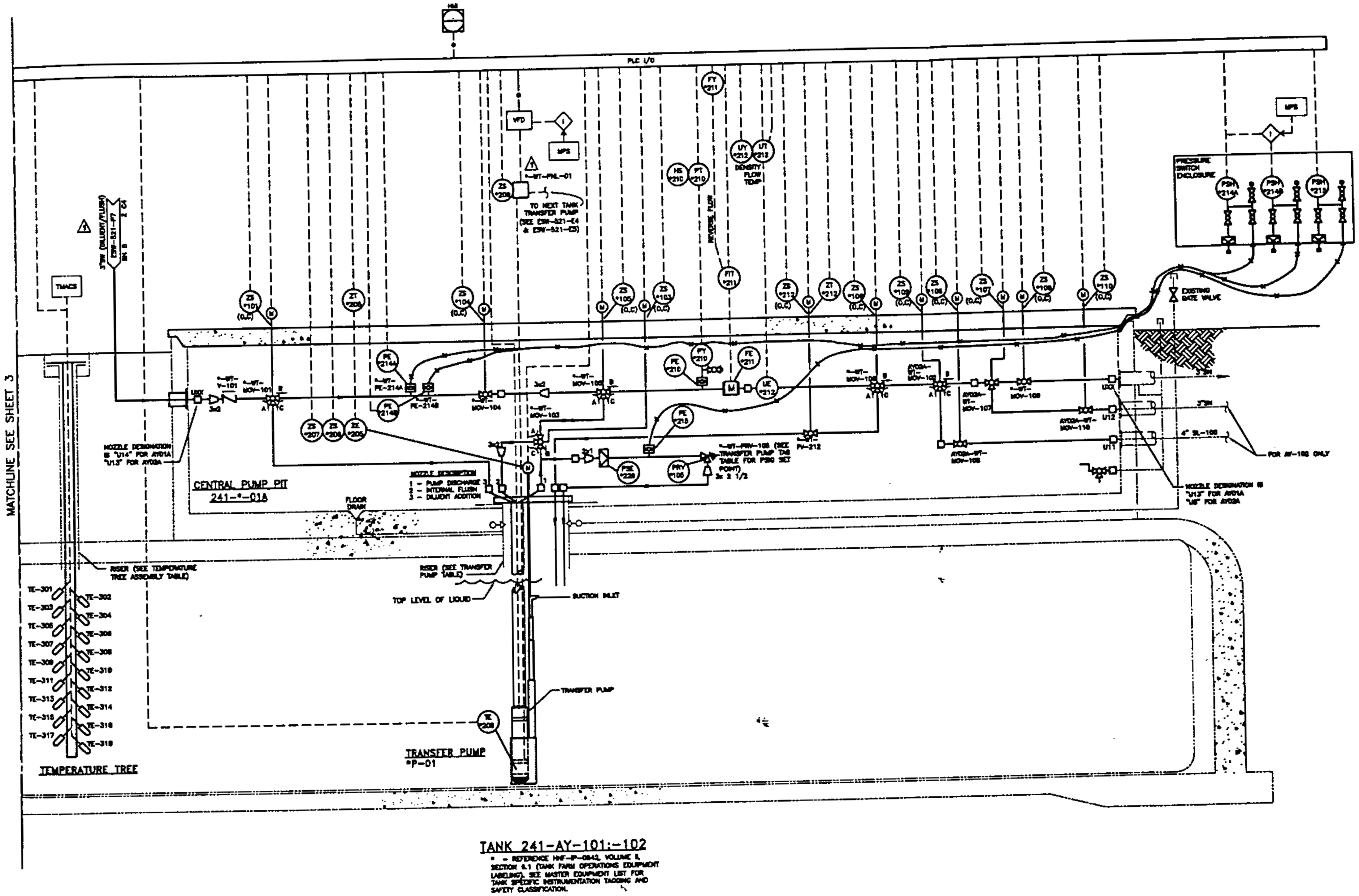
DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

SHEET 4 OF 5

PROJECT ID 9909202.03 | DRAWING NO. ESW-521-P6 | REV. 1

NOTE:

1. SEE SHEET 1 AND 2 FOR EQUIPMENT IDENTIFICATION NAMING LEGEND AND SYMBOLS. SEE SHEET 3 FOR NOTES.



TEMPERATURE TREE ASSEMBLY

AY-101;-102

TAG	TANK	RISER	COMMENTS
AY101-WST-TE-301 THRU 318	AY-101	15A	(SEE NOTE 9)
AY101-WST-TE-301A THRU 318A	AY-101	15D	(SEE NOTE 9)
AY101-WST-TE-301B THRU 318B	AY-101	15H	(SEE NOTE 9)
AY101-WST-TE-301C THRU 318C	AY-101	15L	(SEE NOTE 9)
AY101-WST-TE-301D THRU 318D	AY-101	15P	(SEE NOTE 9)
AY102-WST-TE-301 THRU 318	AY-102	15A	(SEE NOTE 9)
AY102-WST-TE-301A THRU 318A	AY-102	15G	(SEE NOTE 9)
AY102-WST-TE-301B THRU 318B	AY-102	15K	(SEE NOTE 9)
AY102-WST-TE-301C THRU 318C	AY-102	15Q	(SEE NOTE 9)
AY102-WST-TE-301D THRU 318D	AY-102	15S	(SEE NOTE 9)

TRANSFER PUMP SYSTEMS

AY-101;-102

TAG	TANK	RISER	SHARED VFD	RELIEF VALVE SETTING
AY01A-WT-P-01	AY-101	6A	AYICE-WT-VFD-01	400 PSIG
AY02A-WT-P-01	AY-102	6A	AYICE-WT-VFD-01	400 PSIG

VALVE POSITION MATRIX AY-101

OPERATION MODE	MOV-101	MOV-103	MOV-104	MOV-105	MOV-106	MOV-109	FV-212
RECIRCULATE WASTE	–	B	C	C	A	C	O
TRANSFER WASTE	–	B	C	C	B	O	C
** IN-LINE DILUENT ADDITION	A	A	C	–	–	–	–
IN-TANK DILUENT ADDITION	B	A	O	B	A	C	O
FLUSH TRANSFER LINE	B	C	O	B	B	O	C
DRAIN TRANSFER LINE	–	A	–	A	C	O	O
FLUSH RECIRC LINE	B	A	O	B	A	C	O
FLUSH PUMP (PURGE)	B	A	O	A	–	–	–
FLUSH PUMP DISCHARGE	B	B	O	A	C	–	–

** - MAY COMPLETE THIS OPERATION IN CONJUCTION WITH WASTE RECIRCULATION AND WASTE TRANSFER

VALVE POSITION MATRIX AY-102

OPERATION MODE	MOV-101	MOV-102	MOV-103	MOV-104	MOV-105	MOV-106	MOV-107	MOV-108	MOV-109	MOV-110	FV-212
RECIRCULATE WASTE	–	C	B	C	C	A	–	–	–	–	O
** TRANSFER WASTE	–	B	B	C	C	B	B	C	O	C	C
** TRANSFER WASTE U11	–	A	B	C	C	B	C	O	–	–	C
** TRANSFER WASTE U12	–	B	B	C	C	B	A	C	C	O	C
IN-LINE DULUENT ADDITION	A	–	A	C	–	–	–	–	–	–	–
IN-TANK DILUENT ADDITION	B	C	A	O	B	A	–	–	O	–	O
FLUSH U5	B	B	C	O	B	B	B	C	–	C	C
FLUSH U11	B	A	C	O	B	B	C	O	C	–	C
FLUSH U12	B	B	C	O	B	B	A	C	–	O	C
FLUSH PUMP (PURGE)	B	–	A	O	A	C	–	–	–	–	–
FLUSH PUMP DISCHARGE	B	–	C	O	A	C	–	–	–	–	–

** - MAY COMPLETE THIS OPERATION IN CONJUCTION WITH WASTE RECIRCULATION AND WASTE TRANSFER

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.2, 4.9, & 4.16	RM	RM					

Holmes & Narver/DMJM   ARES CORPORATION   Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P & ID WASTE FEED DELIVERY

BLDG. 241-AY

FOR
CH2M HILL HANFORD GROUP, INC.

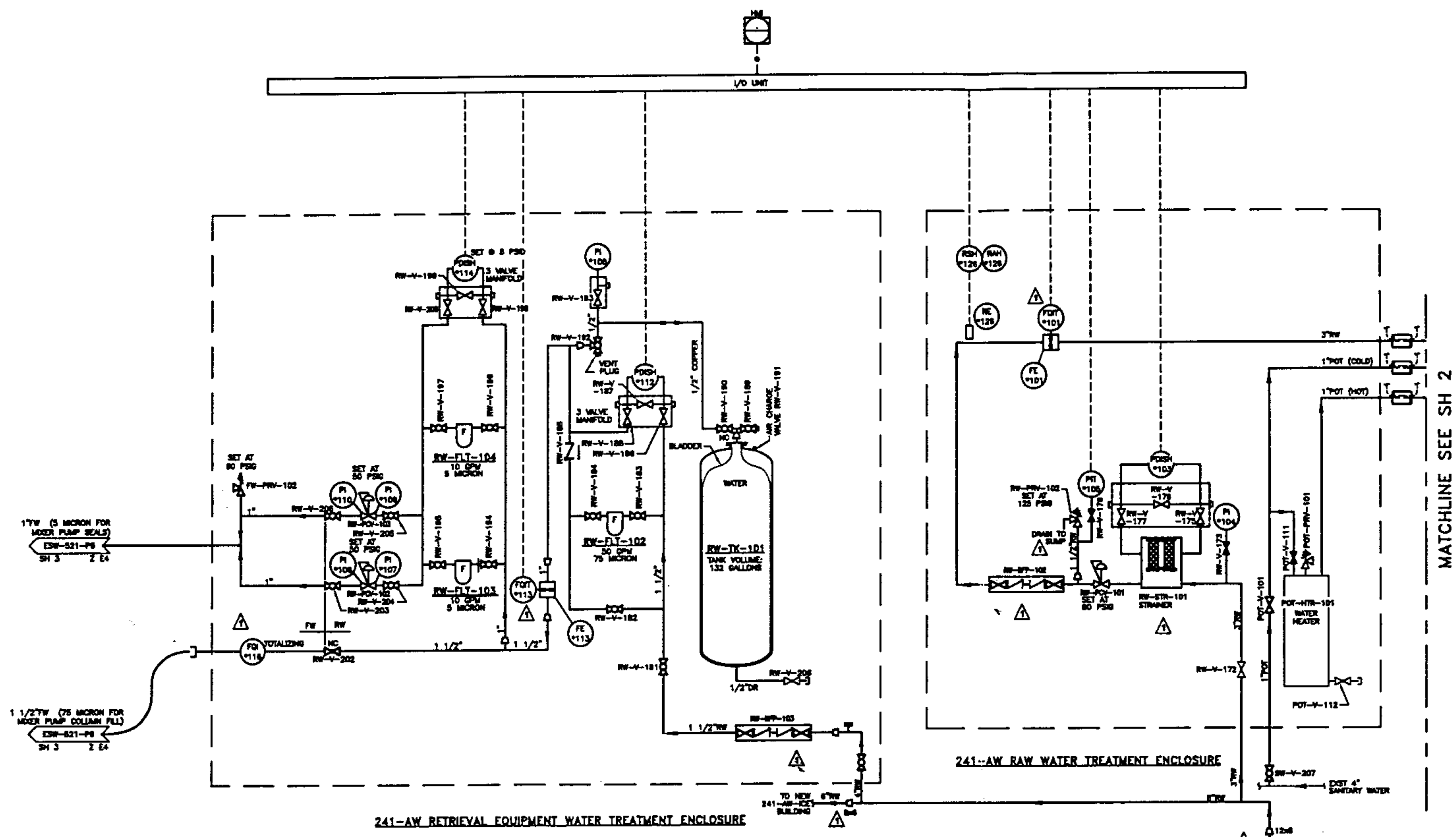
DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

SHEET 5 OF 5

PROJECT ID 9909202.03   DRAWING NO. ESW-521-P6   REV. 1

NOTES:

1. FOR EQUIPMENT/INSTRUMENT IDENTIFICATION LABEL & LEGEND SEE ESW-521-P6 SHEET 1 & 2.
2. REFERENCE HNF-IP-0842, VOLUME II, SECTION 6.1 (TANK FARM OPERATIONS EQUIPMENT LABELING). SEE MASTER EQUIPMENT LIST FOR SYSTEM SPECIFIC INSTRUMENTATION TAGGING AND SAFETY CLASSIFICATION.



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.7 & 4.13	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

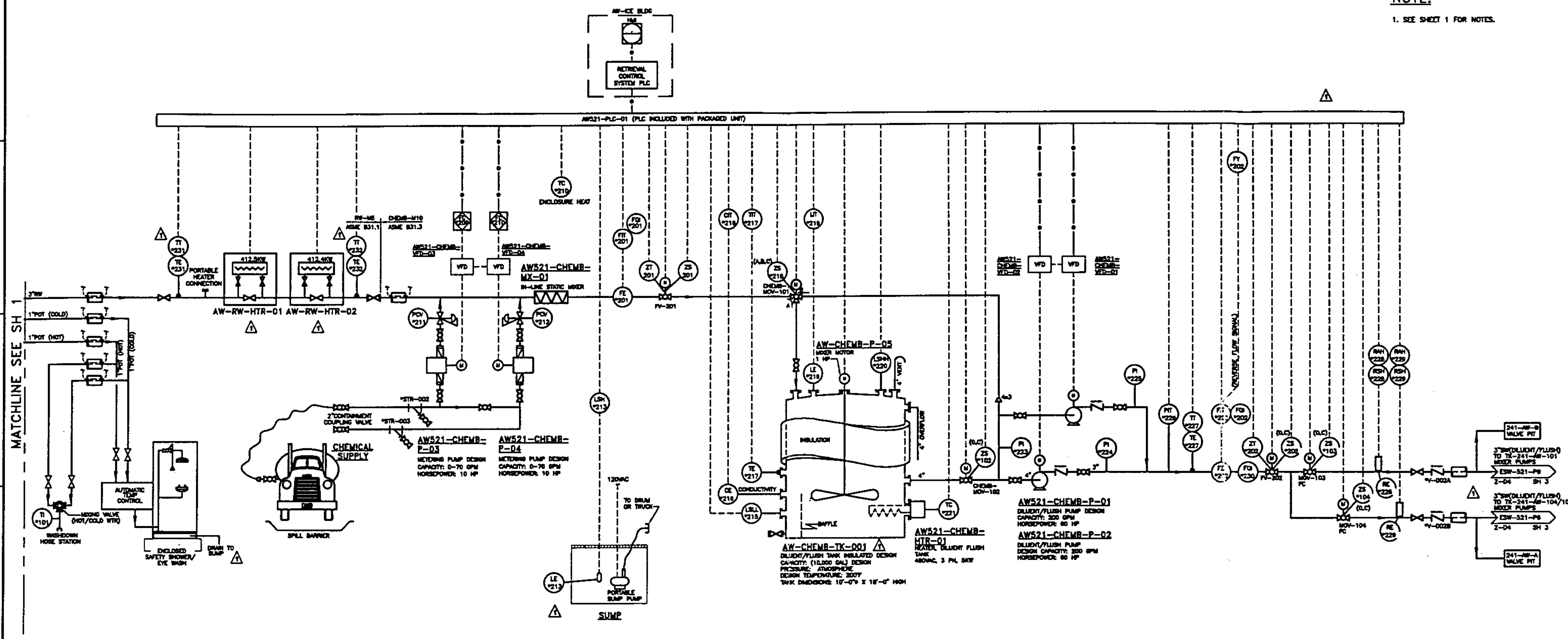
PROJECT W-521 WASTE FEED DELIVERY MECHANICAL P & ID AW WATER TREATMENT RAW/FILTERED/SERVICE	DRAWN	K.S. HALE
	DESIGN	M. GARCIA
	CHECKED	
	RELEASED	
BLDG. 241-AW	DATE	

FOR CH2M HILL HANFORD GROUP, INC. — SHEET 1 OF 5

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-P7 — REV. 1

NOTE: RPP-7069, Rev. 0

1. SEE SHEET 1 FOR NOTES.



241-AW DILUENT AND FLUSH SYSTEM

VALVE POSITION MATRIX						
OPERATION MODE	MOV-101	MOV-102	MOV-103	MOV-104	FV-201	FV-202
NORMAL-OFF	–	–	CLOSED	CLOSED	CLOSED	CLOSED
CHEMB-TK-001 FILL	A	–	CLOSED	CLOSED	OPEN	–
DILUENT TO PIT 241-AW-A	A	OPEN	OPEN	CLOSED	OPEN	OPEN
DILUENT TO PIT 241-AW-B	A	OPEN	CLOSED	OPEN	OPEN	OPEN
FLUSH/ AW-A BYPASS CHEMB-TK-001	B	CLOSED	OPEN	CLOSED	OPEN	OPEN
FLUSH/ AW-B BYPASS CHEMB-TK-001	B	CLOSED	CLOSED	OPEN	OPEN	OPEN

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5, 4.6, & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P & ID AW WATER TREATMENT
DILUENT/FLUSH

BLDG. 241-AW

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN K.S. HALE
DESIGN M. GARCIA
CHECKED
RELEASED
DATE

SHEET 2 OF 5

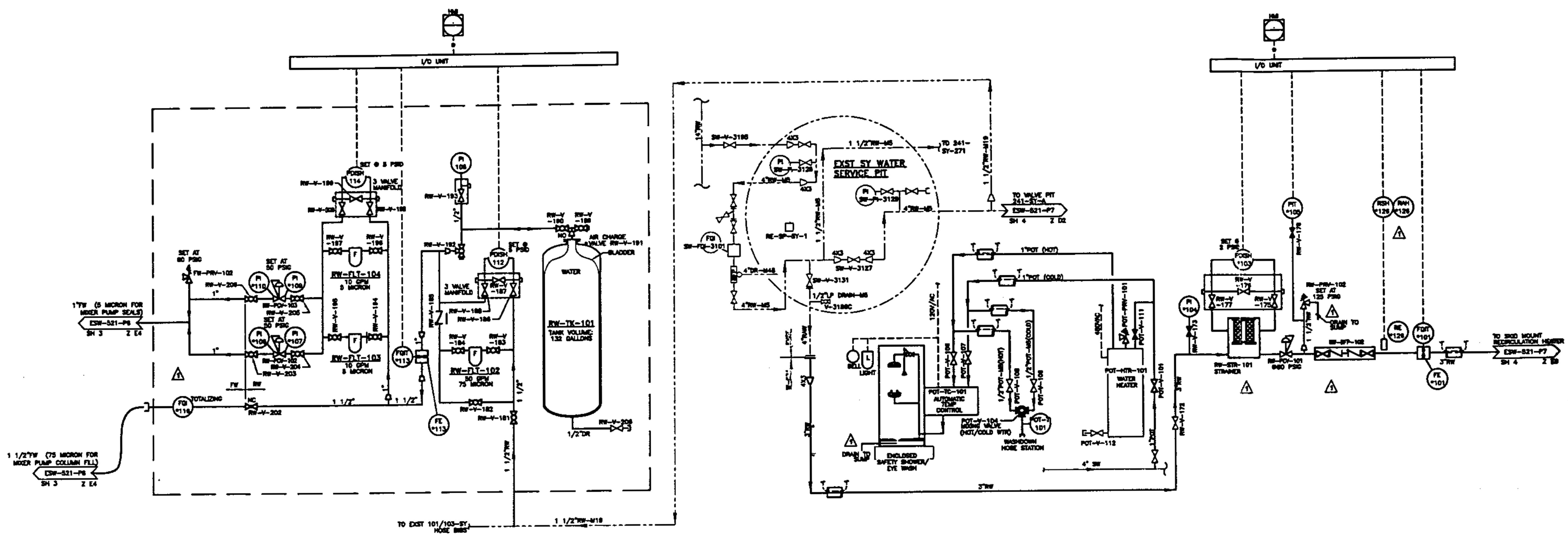
PROJECT ID 9909202.03

DRAWING NO. ESW-521-P7

REV. 1

NOTE:

1. SEE SHEET 1 FOR NOTES.



241-SY RETRIEVAL EQUIPMENT WATER TREATMENT ENCLOSURE

241-SY RAW WATER TREATMENT

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.7 & 4.13	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P & ID SY WATER TREATMENT
RAW/FILTERED/SERVICE

BLDG. 241-SY

FOR
CH2M HILL HANFORD GROUP, INC.

DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

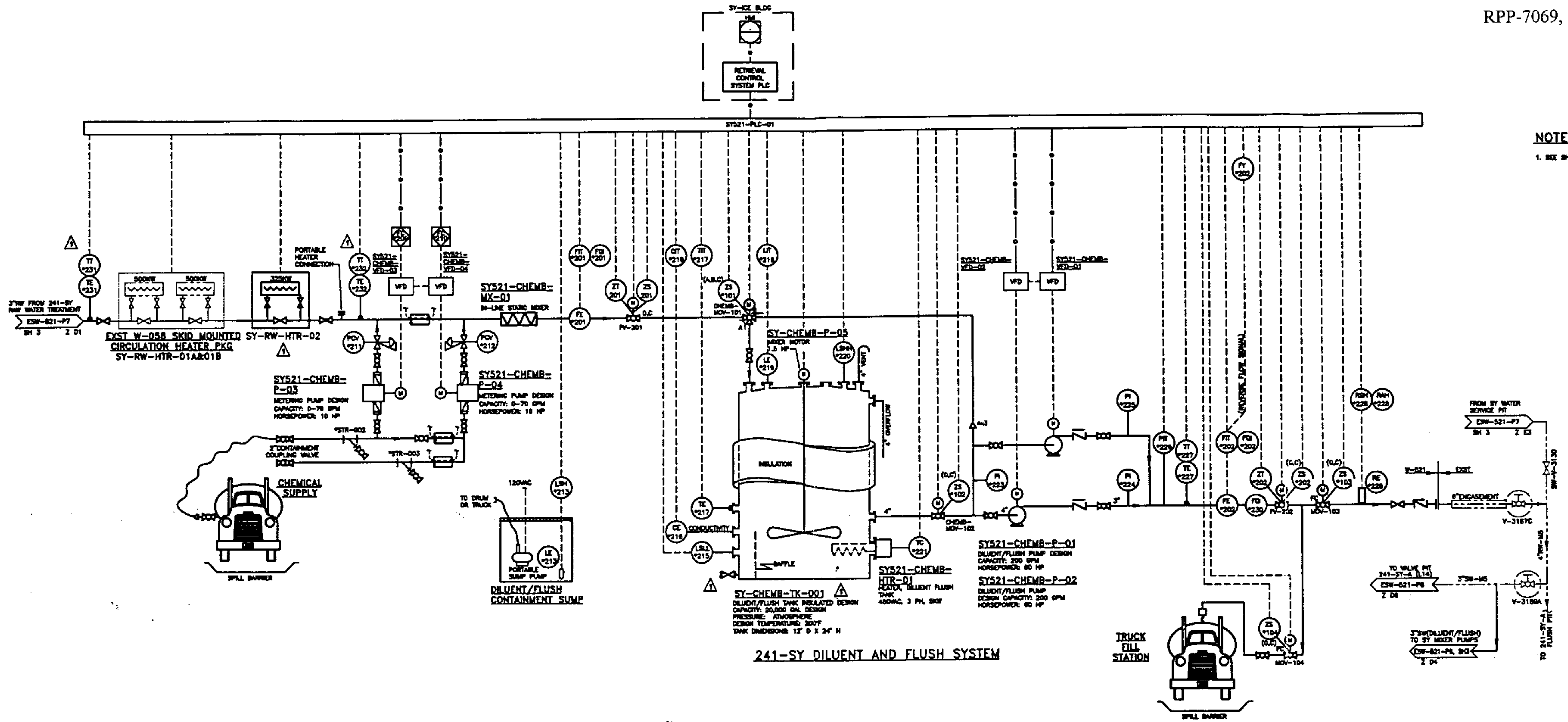
SHEET 3 OF 5

PROJECT ID 9909202.03

DRAWING NO. ESW-521-P7

REV. 1

NOTE:
1. SEE SHEET 1 FOR NOTES.



OPERATION MODE	MOV-101	MOV-102	MOV-103	MOV-104	FV-201	FV-202
NORMAL-OFF	–	–	CLOSED	CLOSED	CLOSED	CLOSED
CHEMB-TK-001 FILL	A	–	CLOSED	CLOSED	OPEN	–
DIL. TO VALVE AND FLUSH PITS 241-SY-A	A	OPEN	OPEN	CLOSED	OPEN	OPEN
TRUCK FILL	A	OPEN	CLOSED	OPEN	OPEN	OPEN
FLUSH/ SY-A BYPASS CHEMB-TK-001	B	CLOSED	OPEN	CLOSED	OPEN	OPEN
TRUCK FILL BYPASS CHEMB-TK-001	B	CLOSED	CLOSED	OPEN	OPEN	OPEN

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.5, 4.6 & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P & ID SY WATER TREATMENT
DILUENT/FLUSH

BLDG. 241-SY

FOR CH2M HILL HANFORD GROUP, INC.

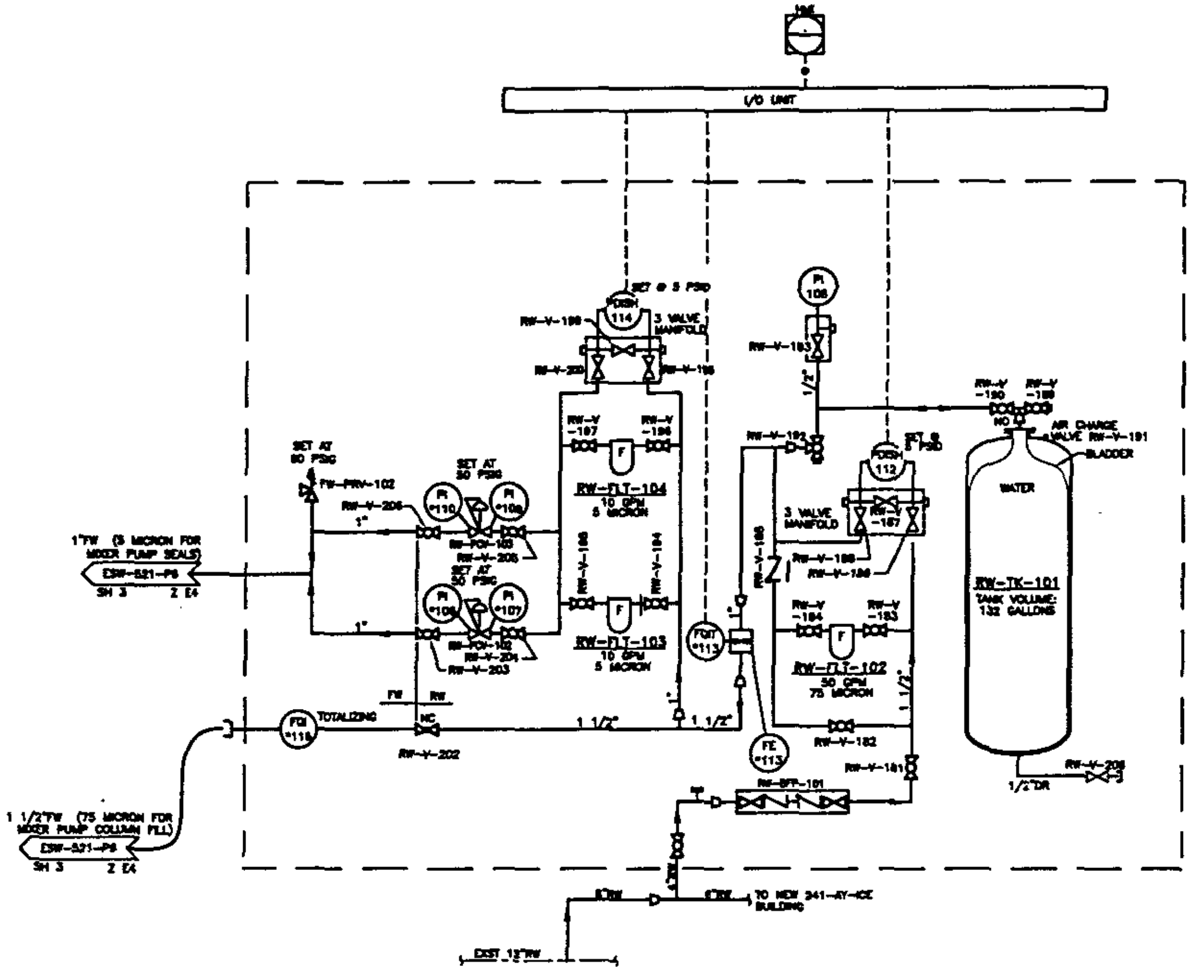
DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

SHEET 4 OF 5

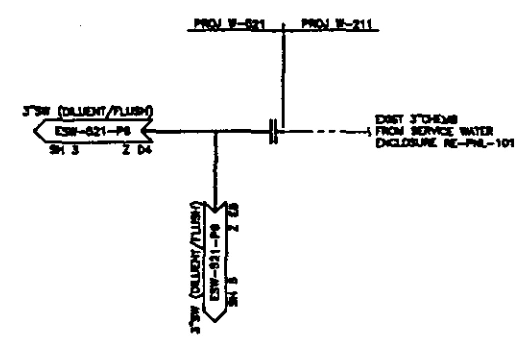
PROJECT ID 9909202.03 — DRAWING NO. ESW-521-P7 — REV. 1

NOTE:

1. SEE SHEET 1 FOR NOTES.



241-AY RETRIEVAL EQUIPMENT WATER TREATMENT ENCLOSURE



241-AY SERVICE WATER

(DILUENT ADDITION/MIXER PUMP INTERNAL FLUSH)

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		NEW DRAWING ADDED PER RPP-7069, R0, PARAGRAPH 4.7 & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P & ID AY WATER TREATMENT
RAW/FILTERED/SERVICE

BLDG. 241-AY

DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

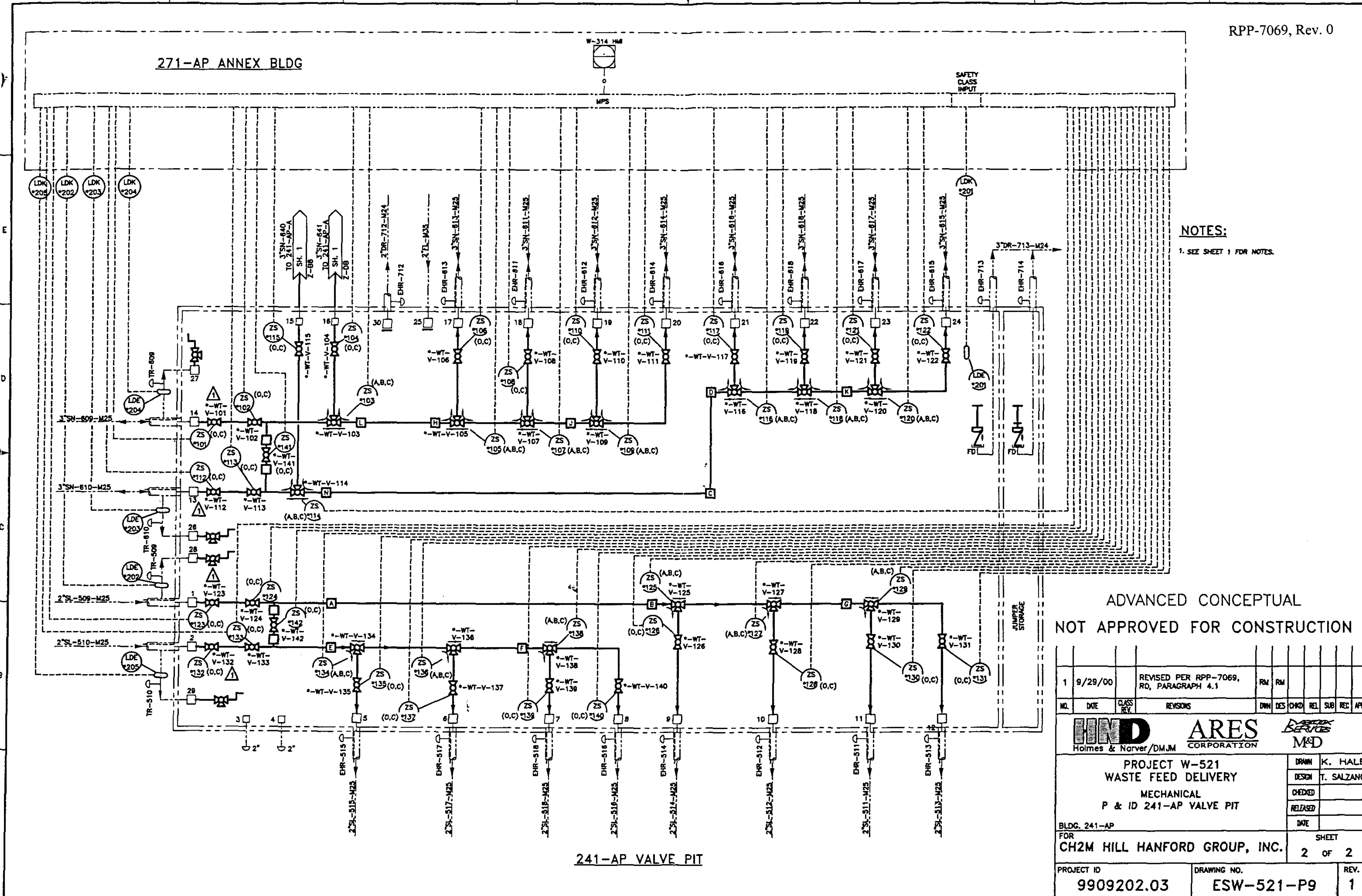
FOR CH2M HILL HANFORD GROUP, INC.

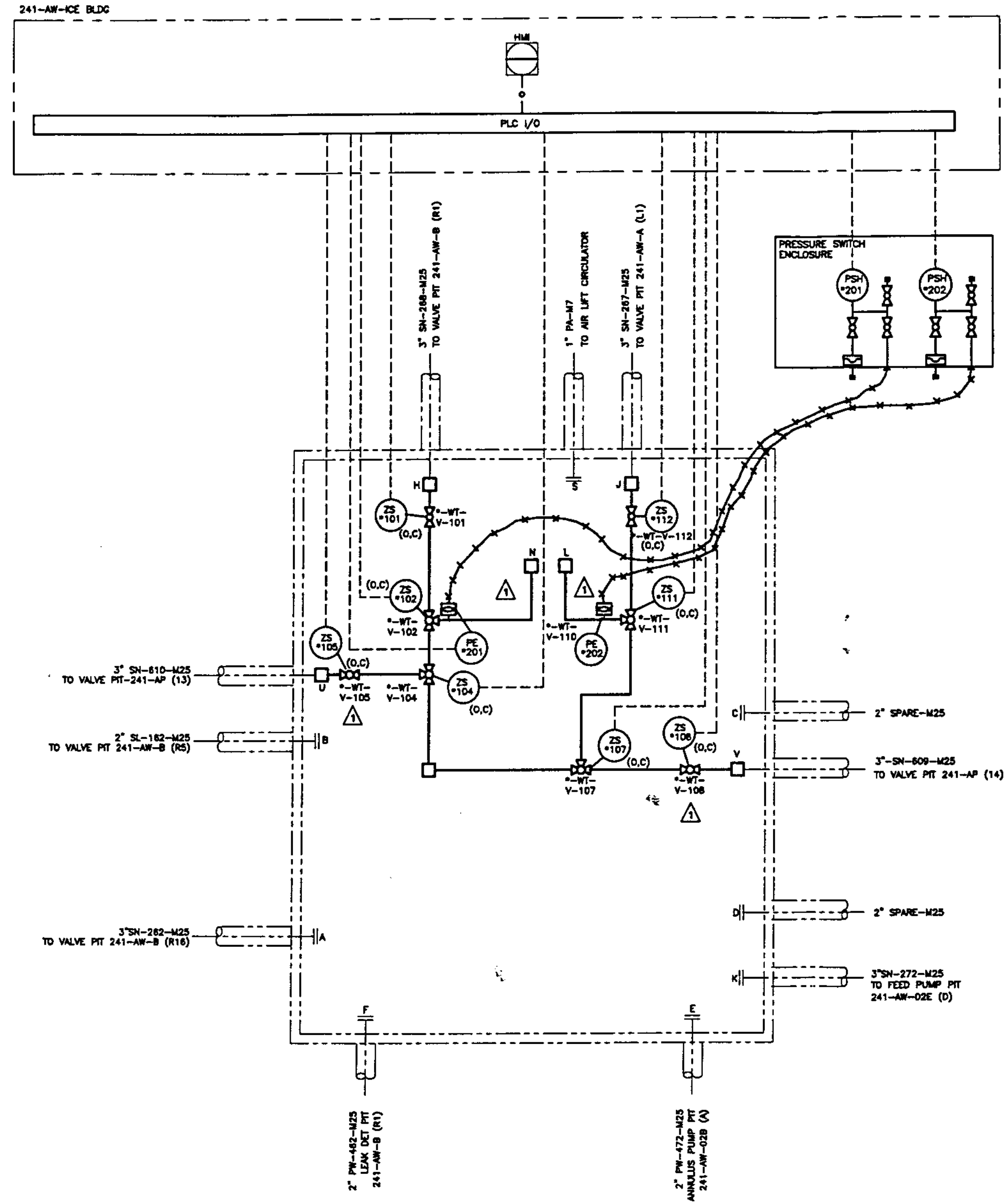
SHEET 5 OF 5

PROJECT ID 9909202.03

DRAWING NO. ESW-521-P7

REV. 0


271-AP ANNEX BLDG
W-314 HMI
MPS
SAFETY CLASS INPUT
NOTES:
1. SEE SHEET 1 FOR NOTES.
241-AP VALVE PIT
JUMPER STORAGE
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
1 9/29/00 REVISED PER RPP-7069, RO, PARAGRAPH 4.1 RM RM
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P & ID 241-AP VALVE PIT
BLDG. 241-AP
FOR
CH2M HILL HANFORD GROUP, INC.
DRAWN K. HALE
DESIGN T. SALZANO
CHECKED
RELEASED
DATE
SHEET 2 OF 2
PROJECT ID 9909202.03
DRAWING NO. ESW-521-P9
REV. 1



PUMP PIT 241-AW-02A

NOTES:

1. FOR EQUIPMENT/INSTRUMENT IDENTIFICATION LABEL & LEGEND SEE ESW-521-P6 SHEET 1 & 2.
2. REFERENCE HNF-IP-0842, VOLUME II, SECTION 6.1 (TANK FARM OPERATIONS EQUIPMENT LABELING). SEE MASTER EQUIPMENT LIST FOR SYSTEM SPECIFIC INSTRUMENTATION, TAGGING AND SAFETY CLASSIFICATION.
3. SEE OUTLINE SPECIFICATION SECTIONS:
   13440
   15493
   16400

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.1	RM	RM					

HND Holmes & Narver/DMJM ARES CORPORATION BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P&ID 241-AW-02A PUMP PIT

BLDG. 241-AW

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN	K. HALE
DESIGN	T SALZANO
CHECKED	
RELEASED	
DATE	

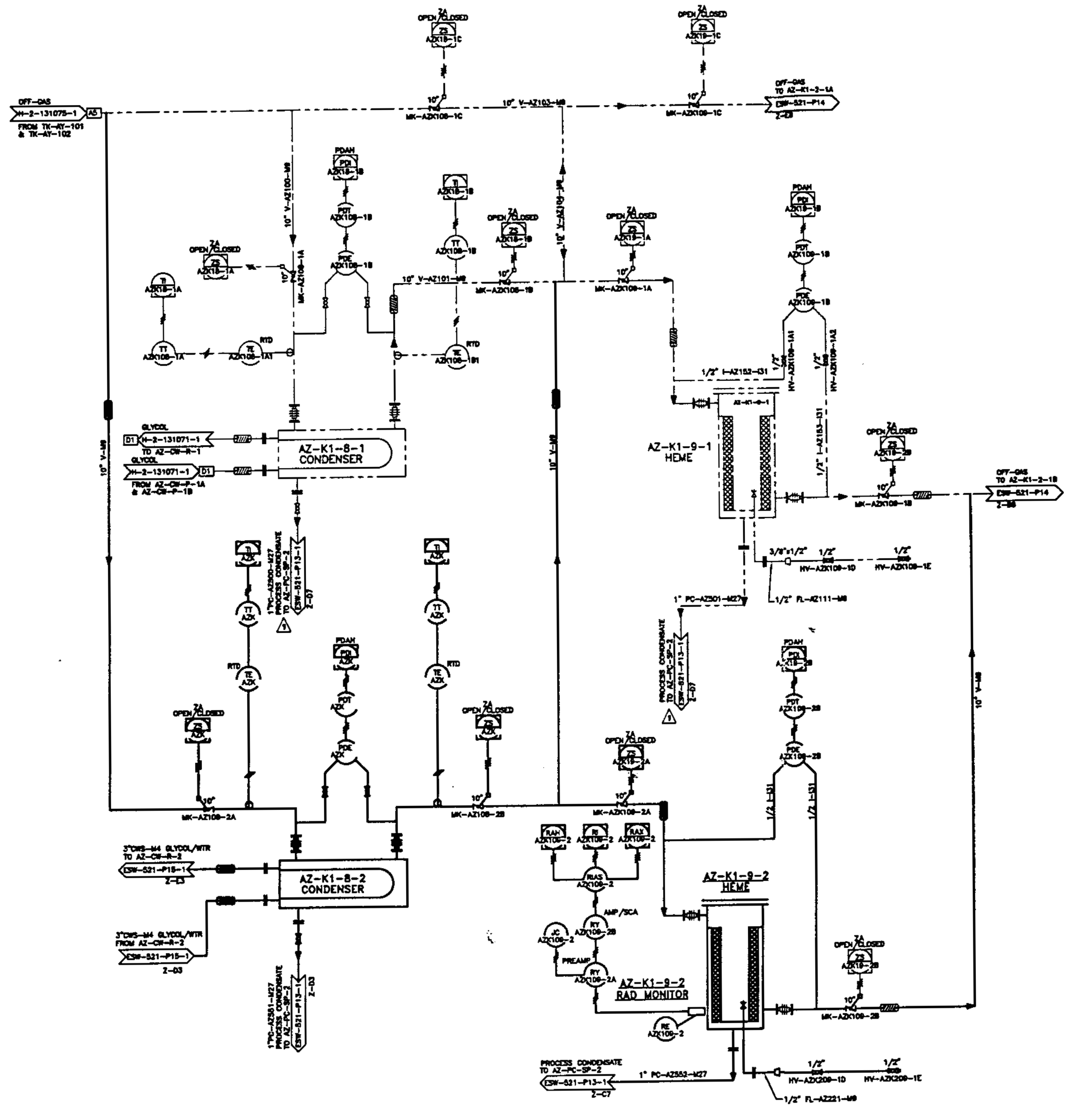
SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ESW-521-P10 | REV. 1

LEGEND

EXISTING

NEW (W-521)



PRIMARY TANK VENT SYSTEM

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P&ID-PRIMARY TANK VENT SYSTEM

DRAWN	RE WILSON
DESIGN	S. PIERCE
CHECKED	
RELEASED	
DATE	

BLDG. 241-AZ-702

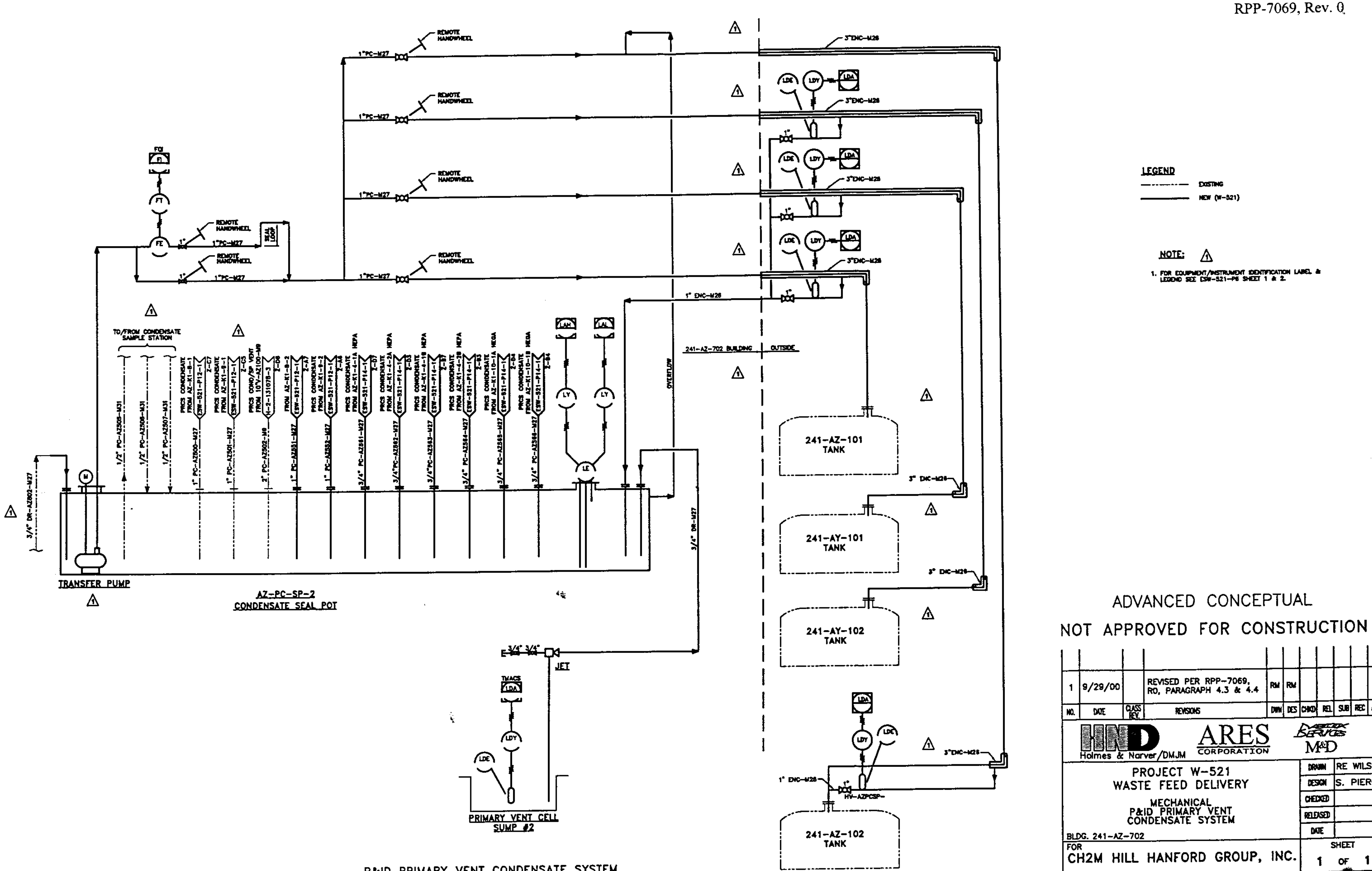
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ESW-521-P12

REV. 1



P&ID PRIMARY VENT CONDENSATE SYSTEM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.3 & 4.4	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P&ID PRIMARY VENT CONDENSATE SYSTEM

DRAWN: RE WILSON
DESIGN: S. PIERCE
CHECKED:
RELEASED:
DATE:

BLDG. 241-AZ-702

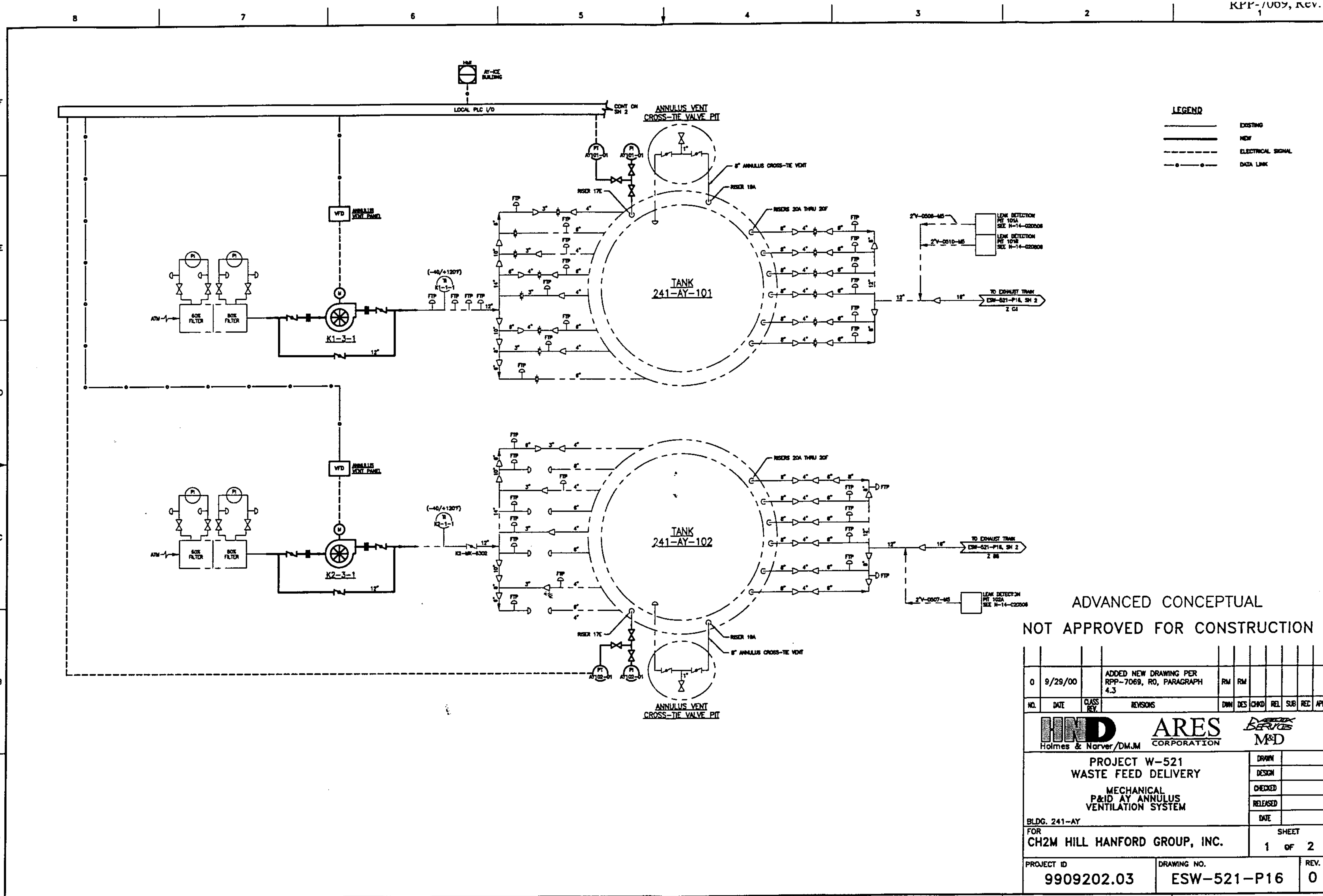
FOR CH2M HILL HANFORD GROUP, INC.

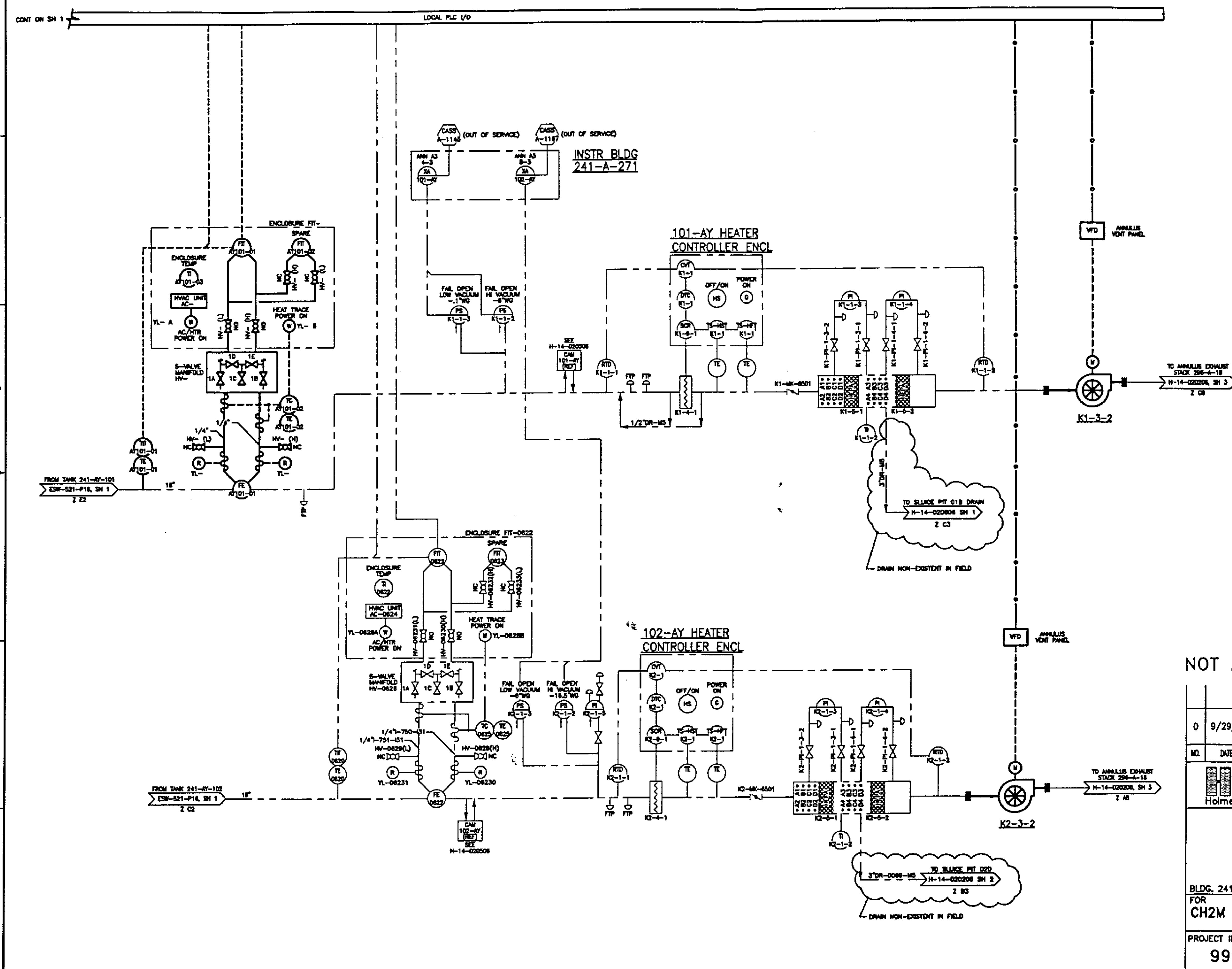
SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ESW-521-P13

REV. 1


LEGEND
EXISTING
NEW
ELECTRICAL SIGNAL
DATA LINK
LOCAL PLC I/O
CONT ON SH 2
ANNULUS VENT CROSS-TIE VALVE PIT
TANK 241-AY-101
TANK 241-AY-102
RISER 17E
RISER 18A
RISERS 20A THRU 20F
8" ANNULUS CROSS-TIE VENT
ANNULUS VENT PANEL
VFD
K1-3-1
K2-3-1
(-40/+120°F)
60% FILTER
80% FILTER
ATM
FTP
TO EXHAUST TRAIN ESW-521-P16, SH 2
LEAK DETECTION PIT 101A SEE H-14-020508
LEAK DETECTION PIT 101B SEE H-14-020508
LEAK DETECTION PIT 102A SEE H-14-020508
2"V-0508-M5
2"V-0510-M5
2"V-0507-M5
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
0 9/29/00 ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3 RM RM
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
M&D
PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
P&ID AY ANNULUS VENTILATION SYSTEM
BLDG. 241-AY
FOR CH2M HILL HANFORD GROUP, INC.
DRAWN
DESIGN
CHECKED
RELEASED
DATE
SHEET 1 OF 2
PROJECT ID 9909202.03
DRAWING NO. ESW-521-P16
REV. 0



NOTES:

1. SEE SHEET 1 FOR LEGEND.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P&ID AY ANNULUS
VENTILATION SYSTEM

BLDG. 241-AY

DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

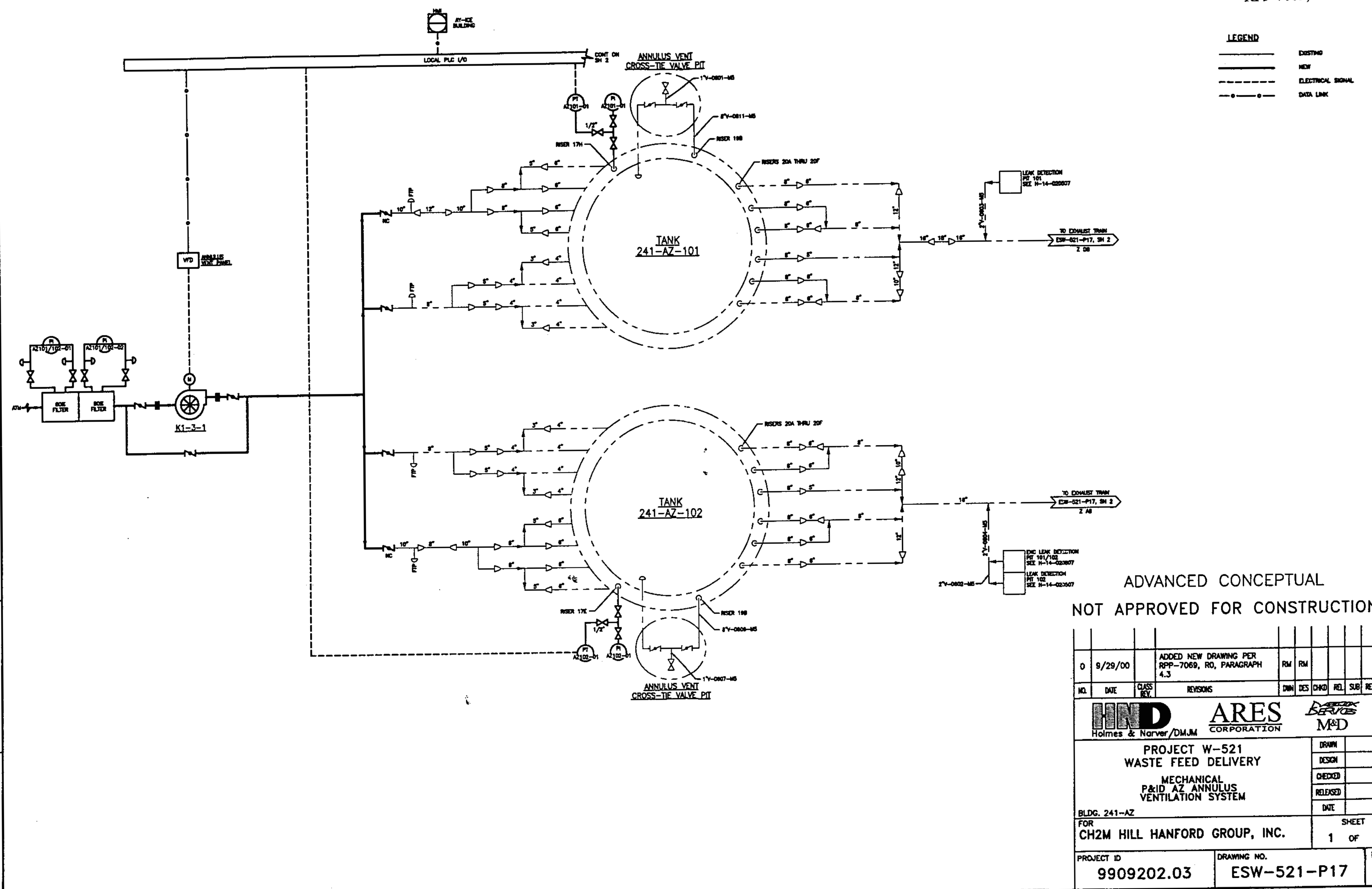
FOR
CH2M HILL HANFORD GROUP, INC.

SHEET 2 OF 2

PROJECT ID 9909202.03

DRAWING NO. ESW-521-P16

REV. 0



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

HND Holmes & Narver/DMJM

ARES CORPORATION

M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P&ID AZ ANNULUS
VENTILATION SYSTEM

BLDG. 241-AZ

FOR
CH2M HILL HANFORD GROUP, INC.

DRAWN
DESIGN
CHECKED
RELEASED
DATE

SHEET 1 OF 2

PROJECT ID 9909202.03

DRAWING NO. ESW-521-P17

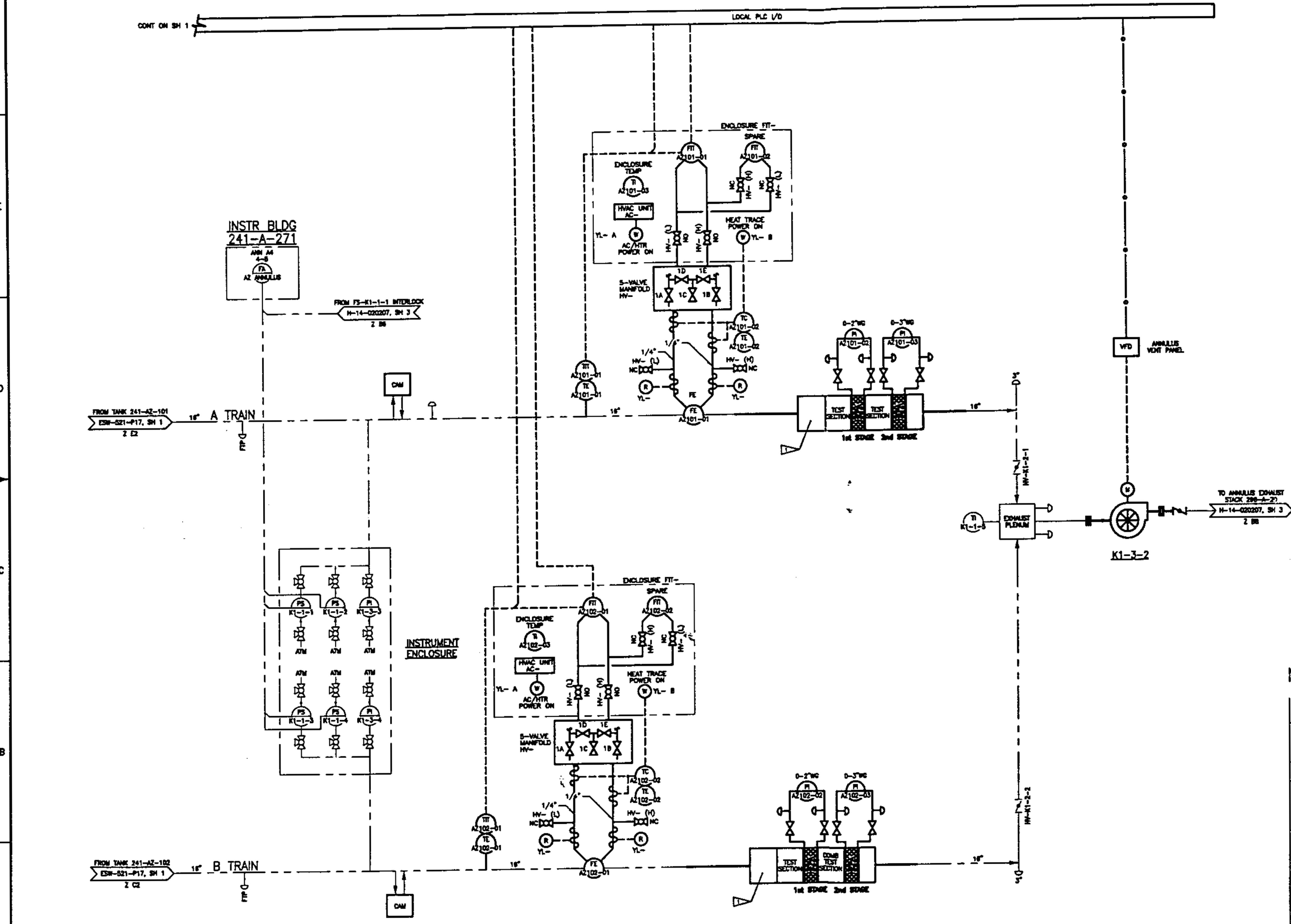
REV. 0

NOTES:

1. SEE SHEET 1 FOR LEGEND.

FLAG NOTES:

COMPARTMENT FOR FUTURE HEATER INSTALLATION (IF REQUIRED)



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
P&ID AZ ANNULUS
VENTILATION SYSTEM

BLDG. 241-AZ

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 2 OF 2

PROJECT ID 9909202.03

DRAWING NO. ESW-521-P17

REV. 0

W-521 PUMP ACTIVITIES

			TRANSFER PUMP ACTIVITIES					MIXER PUMP ACTIVITIES						
LOCATION	WASTE TYPE	TANK FUNCTION	TRANSFER TYPE	PUMP TYPE	PROJECT ACTIVITIES	RISER NUMBER	RISER SIZE	RISER NUMBER	RISER SIZE	PUMP MOUNT	MOTOR	PROJECT ACTIVITIES	VERTICAL INDEXING	NOTES
AW-101	LAW	SOURCE	SUPERNATE & DISSOLVED SOLIDS	DECANT & FULL LENGTH	REMOVE SLURRY DISTRIBUTOR INSTALL TRANSFER PUMP	RISER-012 RISER-012	42" 42"	RISER-007 RISER-008	42" 42"	CONCRETE SLAB CONCRETE SLAB	300HP 300HP	INSTALL MIXER PUMP REMOVE CAMERA/INSTRUMENTS INSTALL MIXER/PUMP	2 DEVICES	PREVIOUSLY DROPPED SUBMERSIBLE TRANSFER PUMP IS IN TANK. REMOVE TRANSFER PUMP IN RISER-005 TO INSTALL TEMPERATURE PROBE ASSEMBLY.
AW-103	HLW	SOURCE	TOTAL TANK	FULL LENGTH	REMOVE SLURRY DISTRIBUTOR INSTALL TRANSFER PUMP	RISER-012 RISER-012	42" 42"	RISER-007 RISER-008	42" 42"	CONCRETE SLAB CONCRETE SLAB	300HP 300HP	INSTALL MIXER PUMP INSTALL MIXER PUMP	2 DEVICES	REMOVE TRANSFER PUMP IN RISER-005 TO INSTALL TEMPERATURE PROBE ASSEMBLY.
AW-104	LAW/HLW	SOURCE & STAGING* * HLW ONLY	SUPERNATE & TOTAL TANK	DECANT & FULL LENGTH	REMOVE SLURRY DISTRIBUTOR INSTALL TRANSFER PUMP	RISER-012 RISER-012	42" 42"	RISER-007 RISER-008	42" 42"	CONCRETE SLAB CONCRETE SLAB	300HP 300HP	INSTALL MIXER PUMP INSTALL MIXER PUMP	2 DEVICES	REMOVE TRANSFER PUMP IN RISER-005 TO INSTALL TEMPERATURE PROBE ASSEMBLY.
AY-101	HLW	SOURCE & STAGING	SUPERNATE & TOTAL TANK	DECANT & FULL LENGTH	REMOVE SLURRY DISTRIBUTOR INSTALL TRANSFER PUMP	RISER-06A RISER-06A	42" 42"	RISER-01C RISER-01A	34" 34"	AY-01B PIT COVER BLOCK AY-01D PIT COVER BLOCK	300HP 300HP	REMOVE TRANSFER PUMP INSTALL MIXER PUMP REMOVE TRANSFER PUMP INSTALL MIXER PUMP	2 DEVICES	
AY-102	HLW	SOURCE & STAGING	SUPERNATE & TOTAL TANK	DECANT & FULL LENGTH	REMOVE SLURRY DISTRIBUTOR INSTALL TRANSFER PUMP	RISER-06A RISER-06A	42" 42"	RISER-01A RISER-01C	34" 34"	AY-02B PIT COVER BLOCK AY-02D PIT COVER BLOCK	300HP 300HP	REMOVE MIXER PUMP INSTALL MIXER PUMP REMOVE TRANSFER PUMP INSTALL MIXER PUMP	2 DEVICES	
SY-101	LAW	SOURCE	SUPERNATE & TOTAL TANK	DECANT & FULL LENGTH	REMOVE MIXER PUMP INSTALL TRANSFER PUMP	RISER-013 RISER-013	42" 42"	RISER-007 RISER-008	42" 42"	CONCRETE SLAB CONCRETE SLAB	300HP 300HP	REMOVE PRE-FABRICATED PUMP PIT AND TRANSFER PUMP INSTALL MIXER PUMP REMOVE MULTI-PORT RISER ASSEMBLY INSTALL MIXER PUMP	2 DEVICES	REMOVE PRE-FAB PIT FROM 007. 008 HAS A USABLE EXISTING PAD. PULL EXISTING MIXER PUMP FROM RISER 013 (DOME LOADING)
SY-102	HLW	SOURCE	SUPERNATE & TOTAL TANK	DECANT & FULL LENGTH	REMOVE TRANSFER PUMP REMOVE AIR LIFT CIRCULATOR INSTALL 1 PUMP	RISER-005 RISER-013 RISER-013	12" 42" 42"	RISER-007 RISER-008	42" 42"	CONCRETE SLAB CONCRETE SLAB	300HP 300HP	REMOVE ANTI-SIPHONING SLURRY DISTRIBUTOR INSTALL MIXER PUMP INSTALL MIXER PUMP	2 DEVICES	
SY-103	LAW	SOURCE	SUPERNATE & TOTAL TANK	DECANT & FULL LENGTH	REMOVE 1 SLURRY DISTRIBUTOR INSTALL 1 PUMP	RISER-013 RISER-013	42" 42"	RISER-007 RISER-008	42" 42"	CONCRETE SLAB CONCRETE SLAB	300HP 300HP	REMOVE CAMERA/INSTRUMENTS INSTALL MIXER PUMP INSTALL MIXER PUMP	2 DEVICES	REMOVE TRANSFER PUMP IN RISER-005 TO INSTALL TEMPERATURE PROBE ASSEMBLY.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RD, PARAGRAPH 4.7	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

W-521 TRANSFER AND MIXER PUMP ACTIVITY SCHEDULE

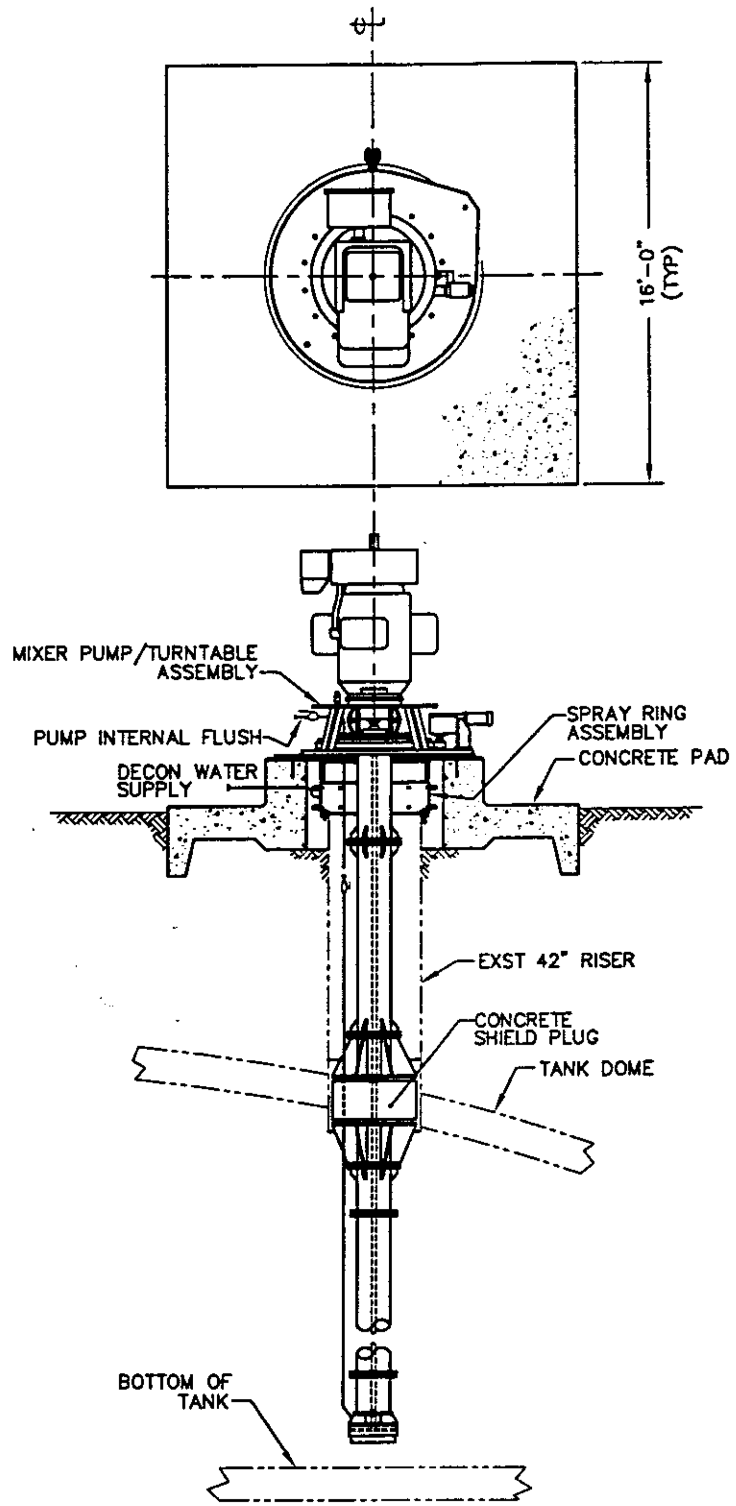
BLDG. 241- AW, AY, AZ & SY

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN	JR BYERS
DESIGN	S. RESENWEBER
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 3

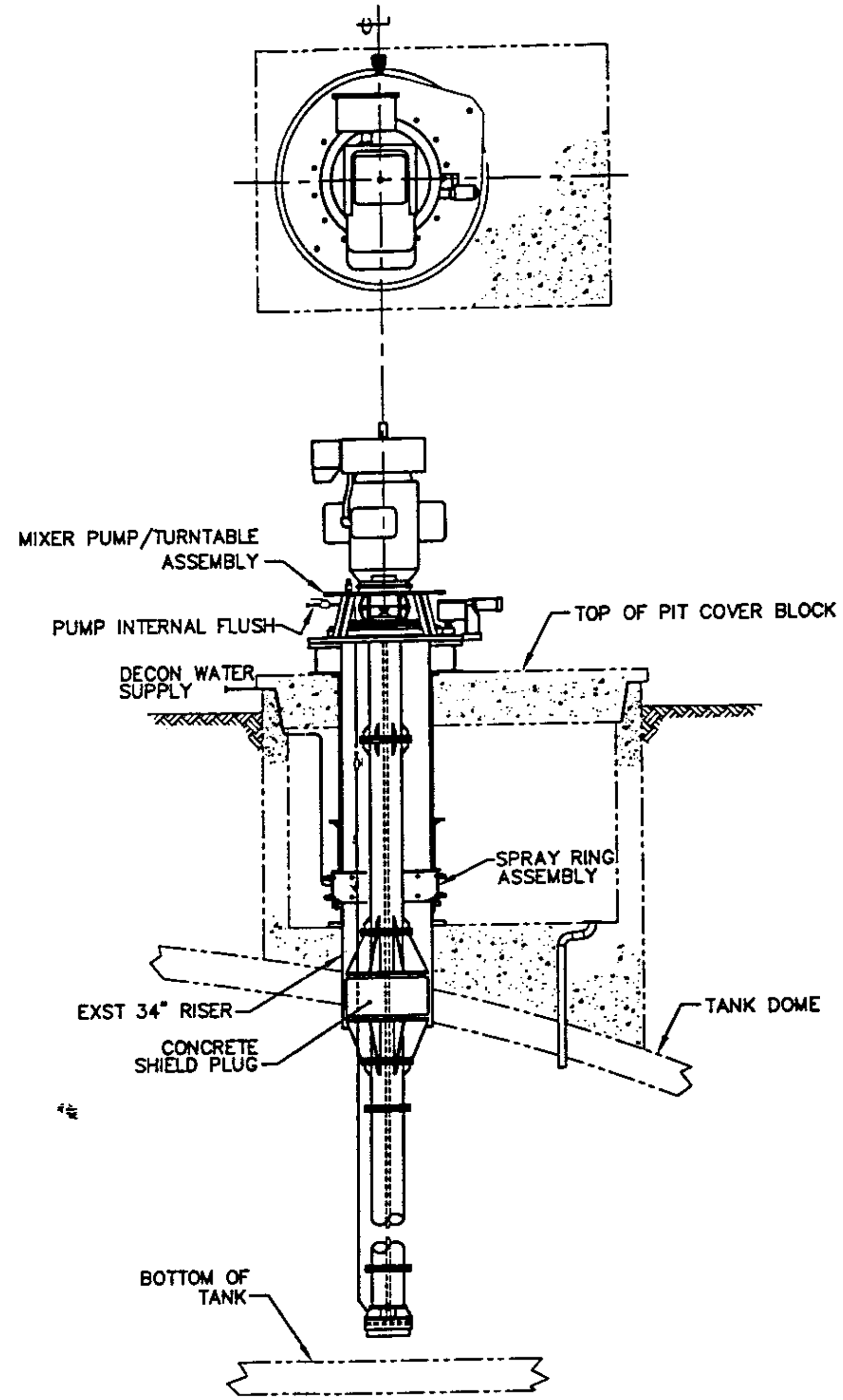
PROJECT ID 9909202.03 — DRAWING NO. ESW-521-M1 — REV. 1



TYPICAL MIXER PUMP
CONCRETE PAD INSTALLATION

SCALE: NONE

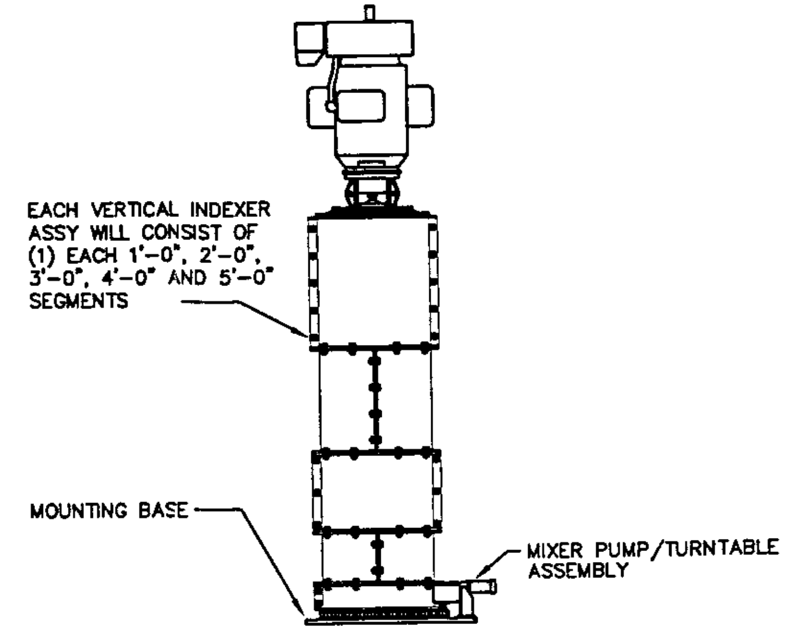
△1 (FOR AW-101, 103, 104 & SY-101, 102, 103 TANKS ONLY)



TYPICAL MIXER PUMP PIT
COVER BLOCK INSTALLATION

SCALE: NONE

△1 (FOR AY-101 & 102 TANKS ONLY)



TYPICAL VERTICAL INDEXER DETAIL

SCALE: NONE

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   03300 05500
   05120 09805
2. APPLY SPECIAL PROTECTIVE COATING TO NEW MIXER PUMP PADS AND SUPPORTS. SEE OUTLINE SPECIFICATION SECTION 09805.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		ADDED TANK LOCATION NOTE TO MIXER PUMP DETAILS	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — Design Services M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
MIXER PUMP INSTALLATION

DRAWN	JR BYERS
DESIGN	S. RESENWEBER
CHECKED	
RELEASED	
DATE	

BLDG. 241- AW, AY & SY

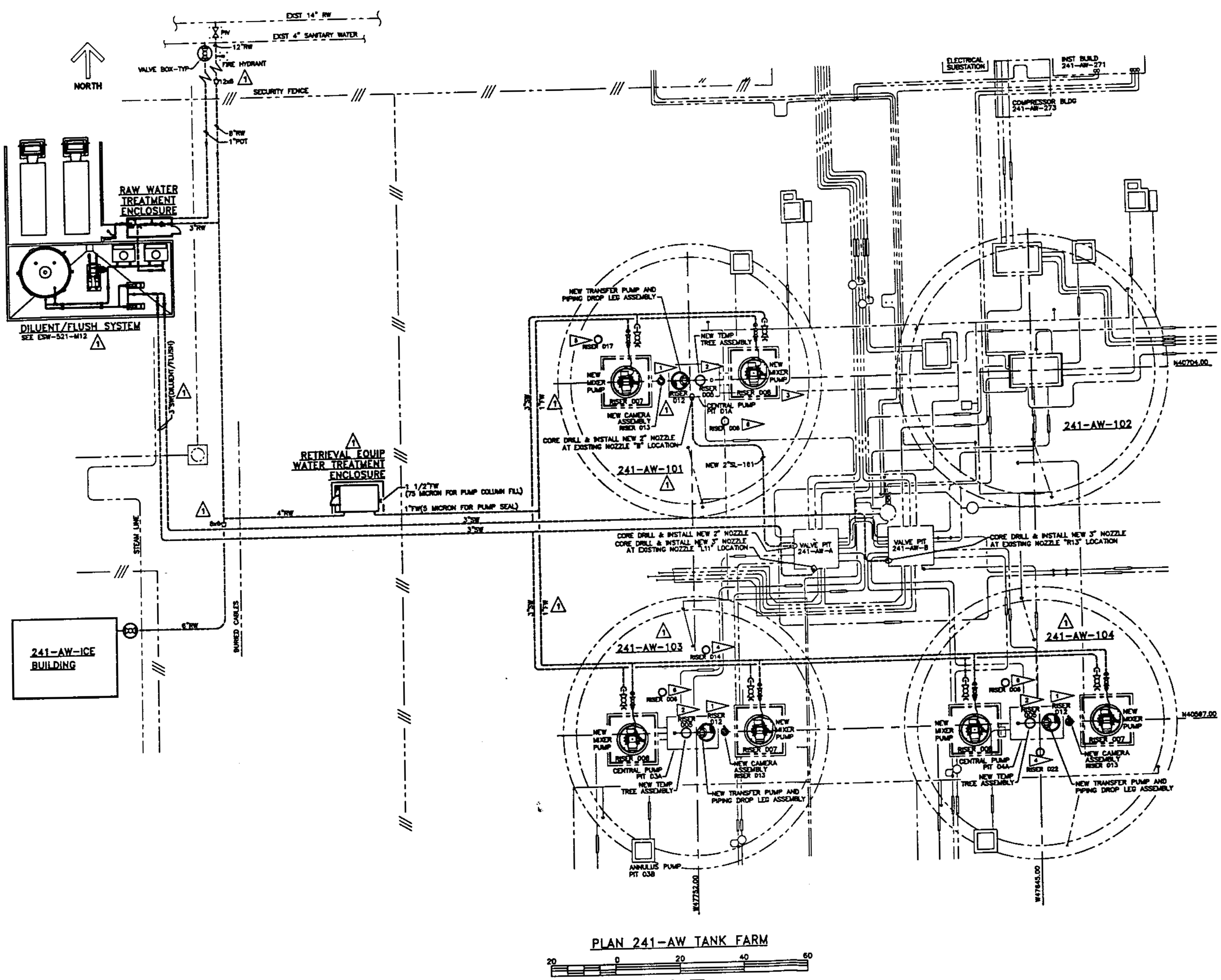
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 2 OF 3

PROJECT ID 9909202.03

DRAWING NO. ESW-521-M1

REV. 1



PLAN 241-AW TANK FARM

SCALE IN FEET

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   15493
   15499
2. SEE ESW-521-P6, SHEET 1 FOR SYSTEM IDENTIFICATION.

FLAG NOTES:

1. EXISTING SLURRY DISTRIBUTER TO BE REMOVED, & DISPOSED.
2. EXISTING TRANSFER PUMP TO BE REMOVED, & DISPOSED.
3. EXISTING CAMERA/INSTRUMENT ASSEMBLY TO BE REMOVED, & DISPOSED.
4. EXISTING OBSERVATION PORT ASSEMBLY TO BE REMOVED, & DISPOSED.
5. EXISTING MULTI-FUNCTION INSTRUMENT TREE TO BE REMOVED & DISPOSED.
6. EXISTING THERMOCOUPLE TREE TO BE REMOVED, & DISPOSED.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5, 4.6, 4.7, 4.10 & 4.16.	RJL	RJL					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
PIPING AND EQUIPMENT PLAN
241-AW TANK FARM

DRAWN	R.LAMOUREUX
DESIGN	T. SALZANO
CHECKED	
RELEASED	
DATE	

BLDG. 241-AW

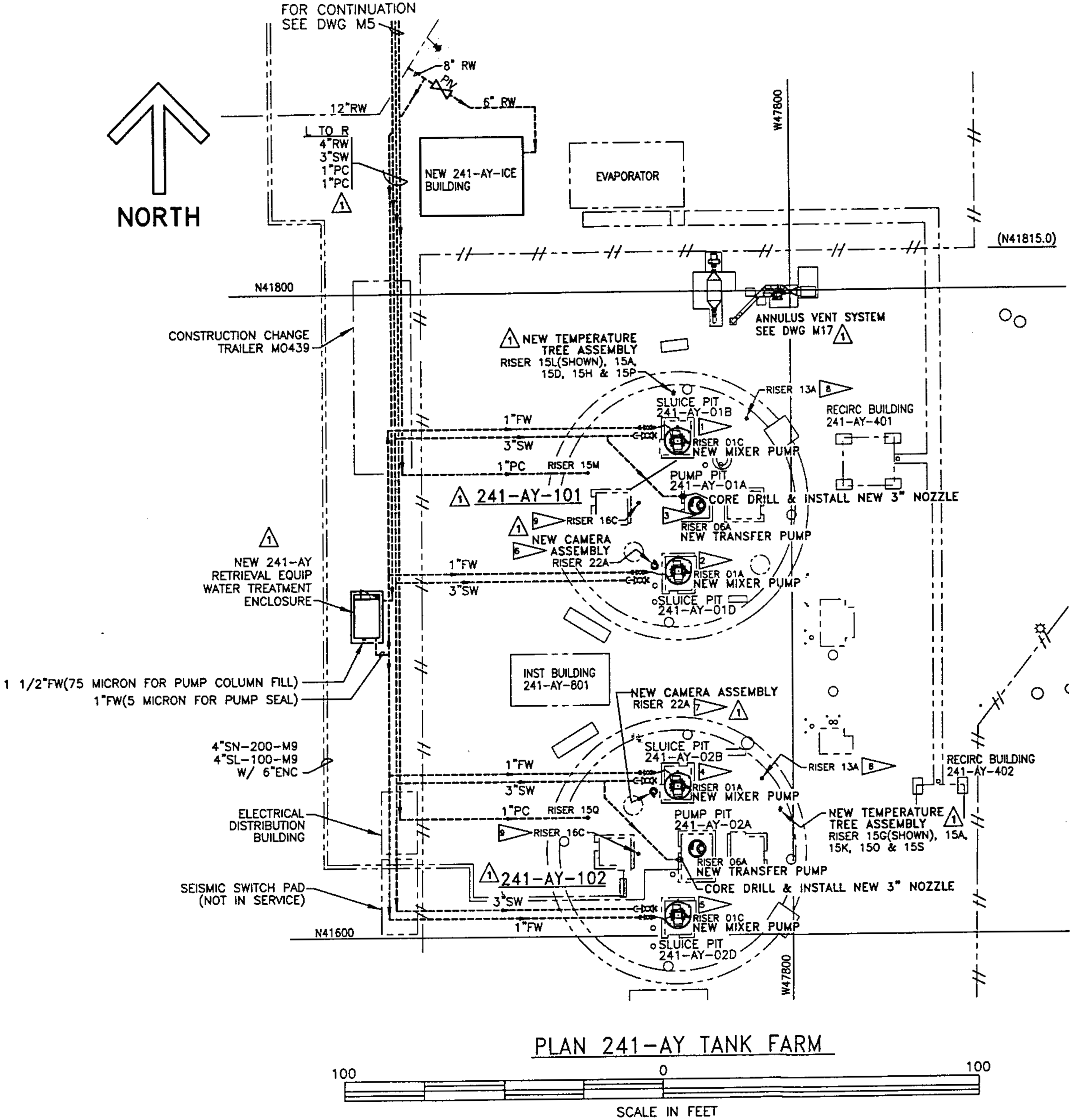
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ESW-521-M3

REV. 1



PLAN 241-AY TANK FARM

NOTE:

1. SEE OUTLINE SPECIFICATION SECTIONS:
15493
15499

FLAG NOTES:

1. EXISTING SUBMERSIBLE PUMP TO BE REMOVED & DISPOSED.
2. EXISTING TRANSFER PUMP TO BE REMOVED & DISPOSED.
3. EXISTING SLURRY DISTRIBUTOR TO BE REMOVED & DISPOSED.
4. EXISTING MIXER PUMP TO BE REMOVED & DISPOSED.
5. EXISTING TRANSFER PUMP TO BE REMOVED & DISPOSED.
6. EXISTING LEVEL INDICATOR TRANSMITTER (ENRAF) TO BE REMOVED AND INSTALLED IN RISER 5A.
7. EXISTING LEVEL INDICATOR TRANSMITTER (FIC) TO BE REMOVED AND INSTALLED IN RISER 5A.
8. EXISTING PROFILE THERMOCOUPLE PROBES TO BE REMOVED & DISPOSED FROM RISERS 13A(SHOWN), 13B, 13C & 13D.
9. EXISTING SLUDGE THERMOCOUPLE PROBES TO BE REMOVED & DISPOSED FROM RISERS 16C(SHOWN), 16A & 16B.

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

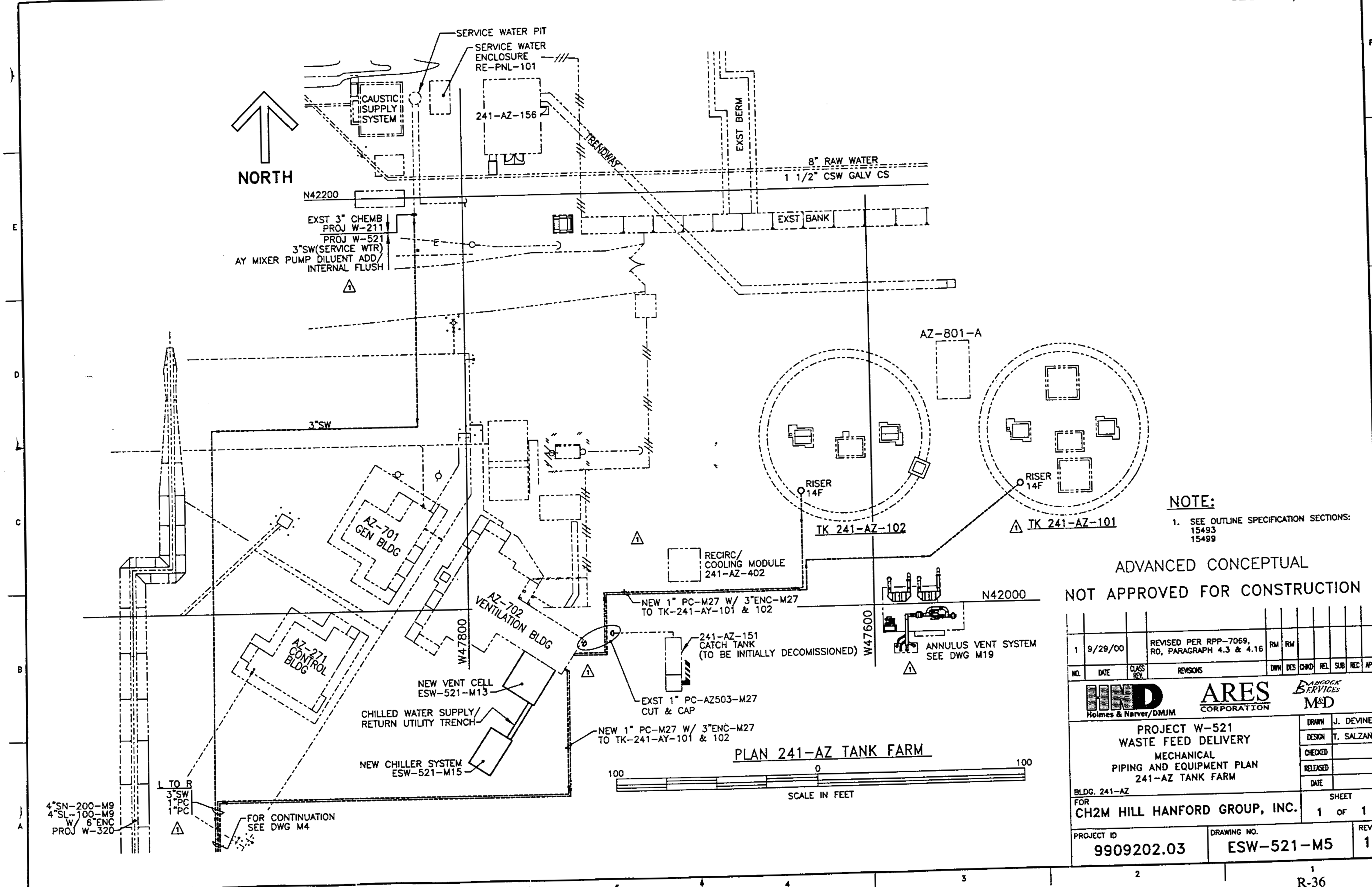
NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.2, 4.3, 4.6, 4.7, 4.10 & 4.16	RM	RM					

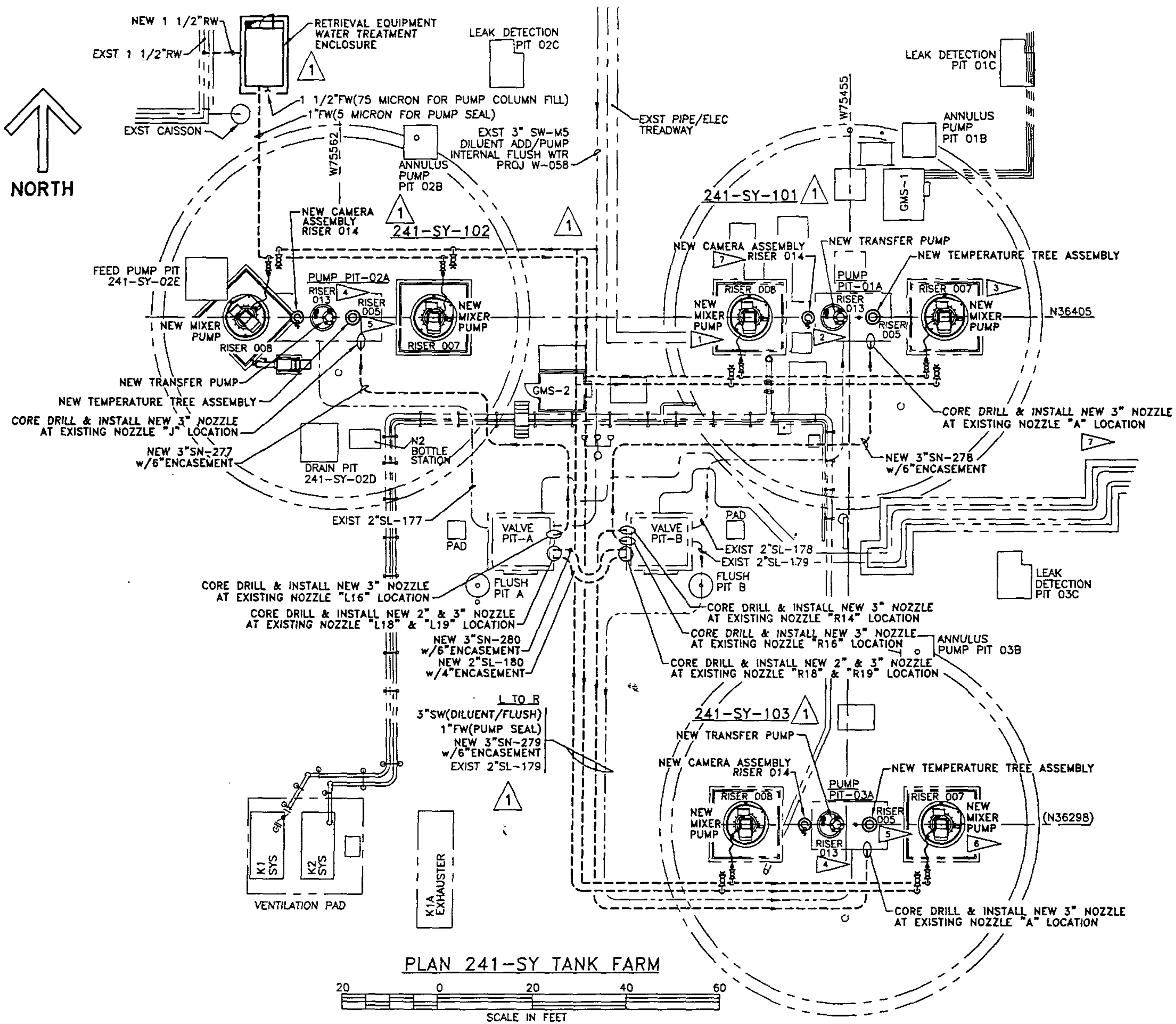
HND Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
PIPING AND EQUIPMENT PLAN
241-AY TANK FARM

DRAWN	J. DEVINE
DESIGN	T. SALZANO
CHECKED	
RELEASED	
DATE	

BLDG. 241-AY
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1
PROJECT ID 9909202.03
DRAWING NO. ESW-521-M4
REV. 1


SERVICE WATER PIT
SERVICE WATER ENCLOSURE RE-PNL-101
CAUSTIC SUPPLY SYSTEM
241-AZ-156
TRENDWAY
EXST BERM
8" RAW WATER
1 1/2" CSW GALV CS
NORTH
N42200
EXST BANK
EXST 3" CHEMB PROJ W-211
PROJ W-521
3"SW(SERVICE WTR)
AY MIXER PUMP DILUENT ADD/
INTERNAL FLUSH
3"SW
AZ-801-A
RISER 14F
TK 241-AZ-102
RISER 14F
TK 241-AZ-101
NOTE:
1. SEE OUTLINE SPECIFICATION SECTIONS: 15493 15499
AZ-701 GEN BLDG
AZ-702 VENTILATION BLDG
AZ-271 CONTROL BLDG
W47800
RECIRC/ COOLING MODULE 241-AZ-402
NEW 1" PC-M27 W/ 3"ENC-M27 TO TK-241-AY-101 & 102
241-AZ-151 CATCH TANK (TO BE INITIALLY DECOMISSIONED)
W47600
N42000
ANNULUS VENT SYSTEM SEE DWG M19
ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION
NEW VENT CELL ESW-521-M13
CHILLED WATER SUPPLY/ RETURN UTILITY TRENCH
NEW CHILLER SYSTEM ESW-521-M15
EXST 1" PC-AZ503-M27 CUT & CAP
NEW 1" PC-M27 W/ 3"ENC-M27 TO TK-241-AY-101 & 102
PLAN 241-AZ TANK FARM
100 0 100
SCALE IN FEET
L TO R
3"SW
1"PC
1"PC
4"SN-200-M9
4"SL-100-M9
W/ 6"ENC
PROJ W-320
FOR CONTINUATION SEE DWG M4
1 9/29/00 REVISED PER RPP-7069, R0, PARAGRAPH 4.3 & 4.16 RM RM
NO. DATE CLASS REV. REVISIONS DWN DES CHKD REL SUB REC APP
Holmes & Narver/DMJM
ARES CORPORATION
BABCOCK SERVICES M&D
PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
PIPING AND EQUIPMENT PLAN
241-AZ TANK FARM
DRAWN J. DEVINE
DESIGN T. SALZANO
CHECKED
RELEASED
DATE
BLDG. 241-AZ
FOR
CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1
PROJECT ID 9909202.03
DRAWING NO. ESW-521-M5
REV. 1



PLAN 241-SY TANK FARM

NOTE:

1. SEE OUTLINE SPECIFICATION SECTIONS: 15493 15499
2. SEE ESW-521-P6, SHEET 1 FOR SYSTEM IDENTIFICATION.

FLAG NOTES: 1

1. EXISTING MULTIPORT RISER & CAMERA ASSEMBLY TO BE REMOVED & BURIED.
2. EXISTING MIXER PUMP P-001 TO BE REMOVED & DISPOSED.
3. EXISTING PRE-FAB PUMP PIT SY101-WT-ENCL-350 AND TRANSFER PUMP P-350 TO BE REMOVED AND DISPOSED.
4. EXISTING SLURRY DISTRIBUTER/AIR LIFT CIRCULATOR TO BE REMOVED AND DISPOSED.
5. EXISTING TRANSFER PUMP TO BE REMOVED & DISPOSED.
6. EXISTING CAMERA ASSEMBLY TO BE REMOVED & DISPOSED.
7. EXISTING RADAR LEVEL GUAGE TO BE REMOVED & DISPOSED.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.2, 4.7, 4.10, & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
PIPING AND EQUIPMENT PLAN
241-SY TANK FARM

BLDG. 241-SY

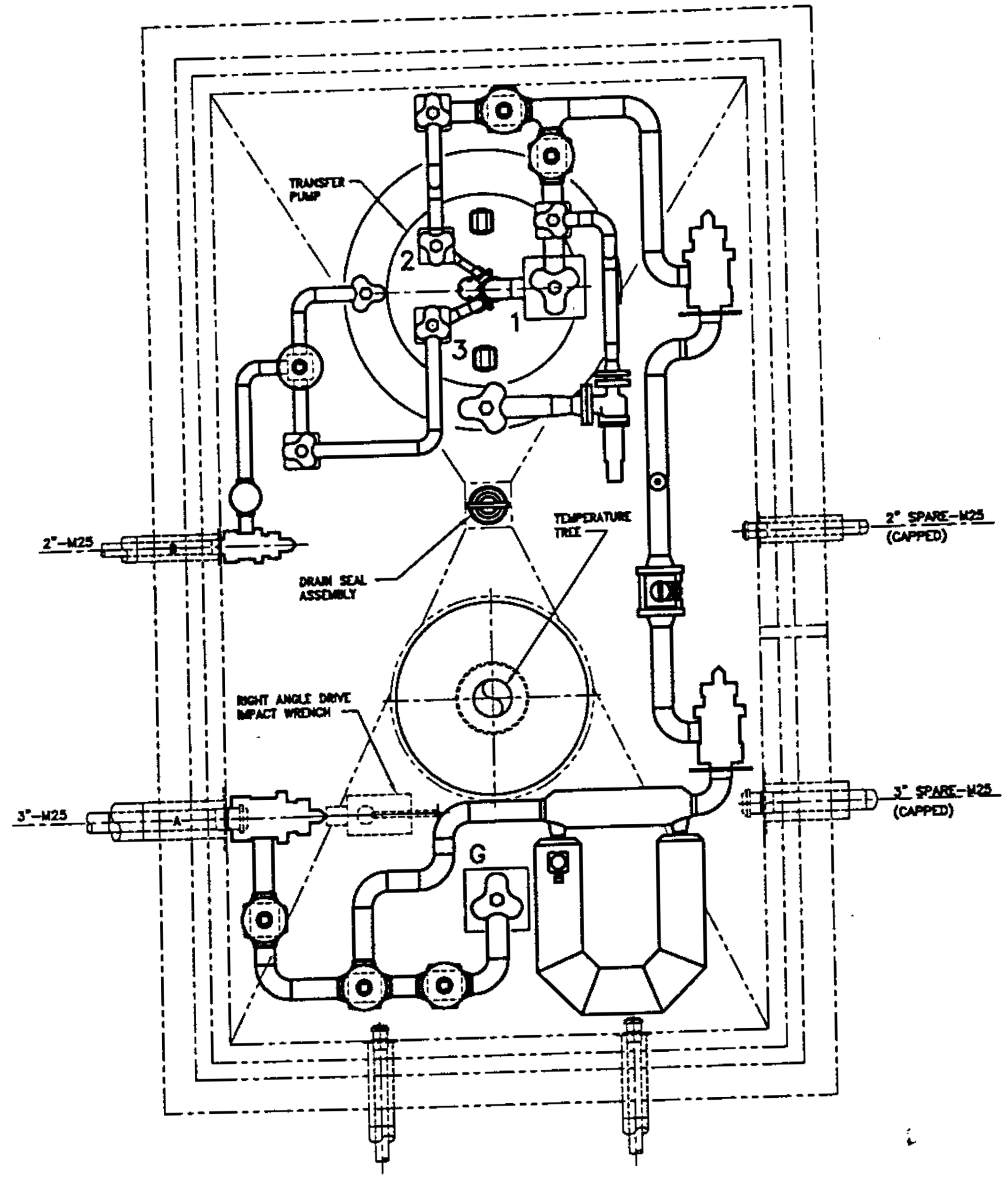
DRAWN	R.LAMOUREUX
DESIGN	T. SALZANO
CHECKED	
RELEASED	
DATE	

FOR CH2M HILL HANFORD GROUP, INC.

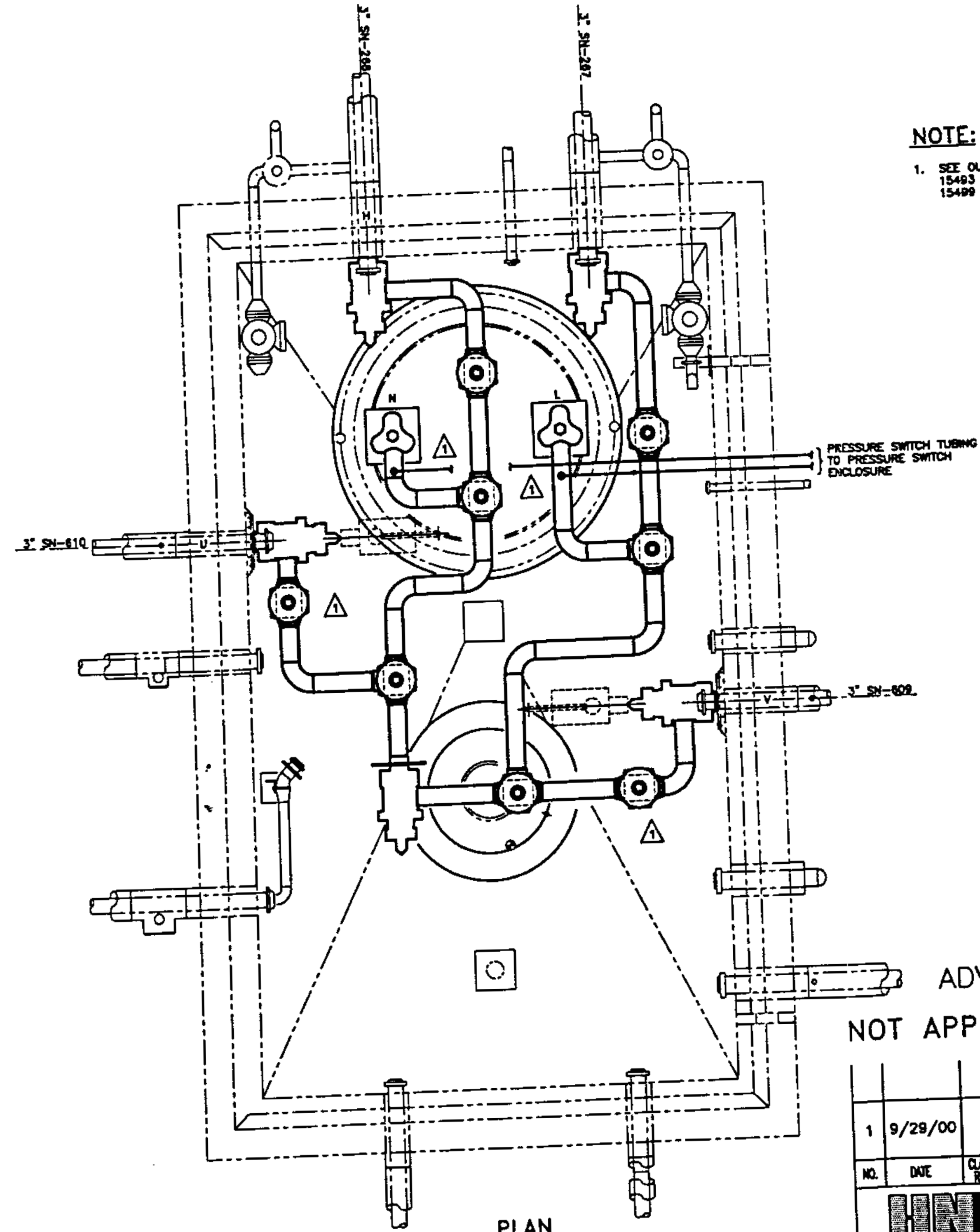
SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-M6	1

NOTE:
1. SEE OUTLINE SPECIFICATION SECTIONS:
15483
15499



PLAN
CENTRAL PUMP PIT
241-AW-01A/03A/04A
241-SY-01A/02A/03A
SCALE: NONE
(SHOWN WITH COVER BLOCKS REMOVED)



PLAN
CENTRAL PUMP PIT
241-AW-02A
SCALE: NONE
(SHOWN WITH COVER BLOCKS REMOVED)

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.1	RM	RM					

Holmes & Narver/DMJM ARES CORPORATION M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL TRANSFER PUMP PIT PLAN
241-AW-01A/02A/
03A/04A;-SY-01A/02A/03A
BLDG. 241-AW,-SY
FOR
CH2M HILL HANFORD GROUP, INC.

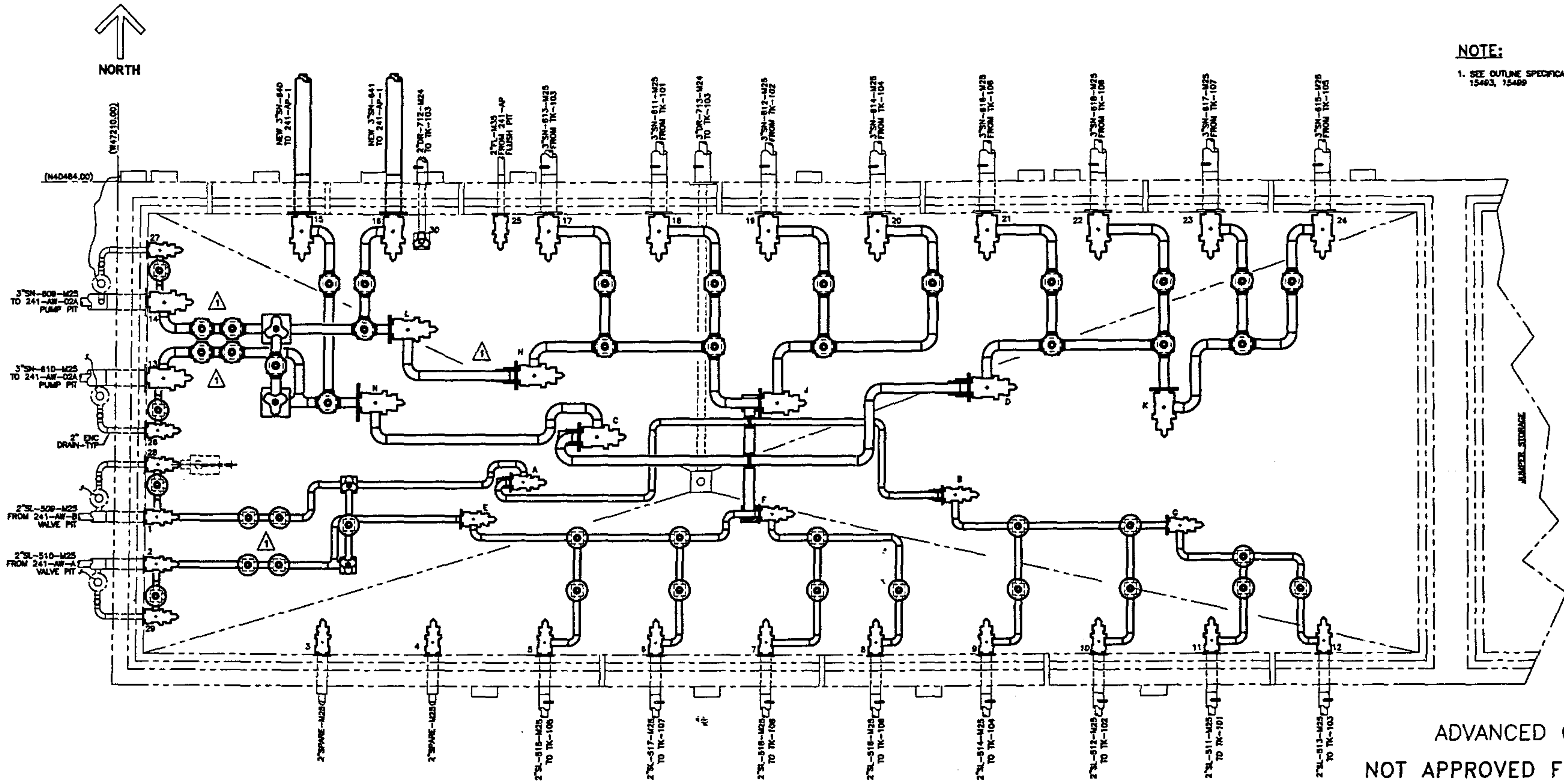
DRAWN	JR BYERS
DESIGN	T SALZANO
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ESW-521-M7 | REV. 1

NOTE:

1. SEE OUTLINE SPECIFICATION SECTIONS: 15493, 15499



PLAN
VALVE PIT 241-AP

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.1	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
PLAN
241-AP VALVE PIT

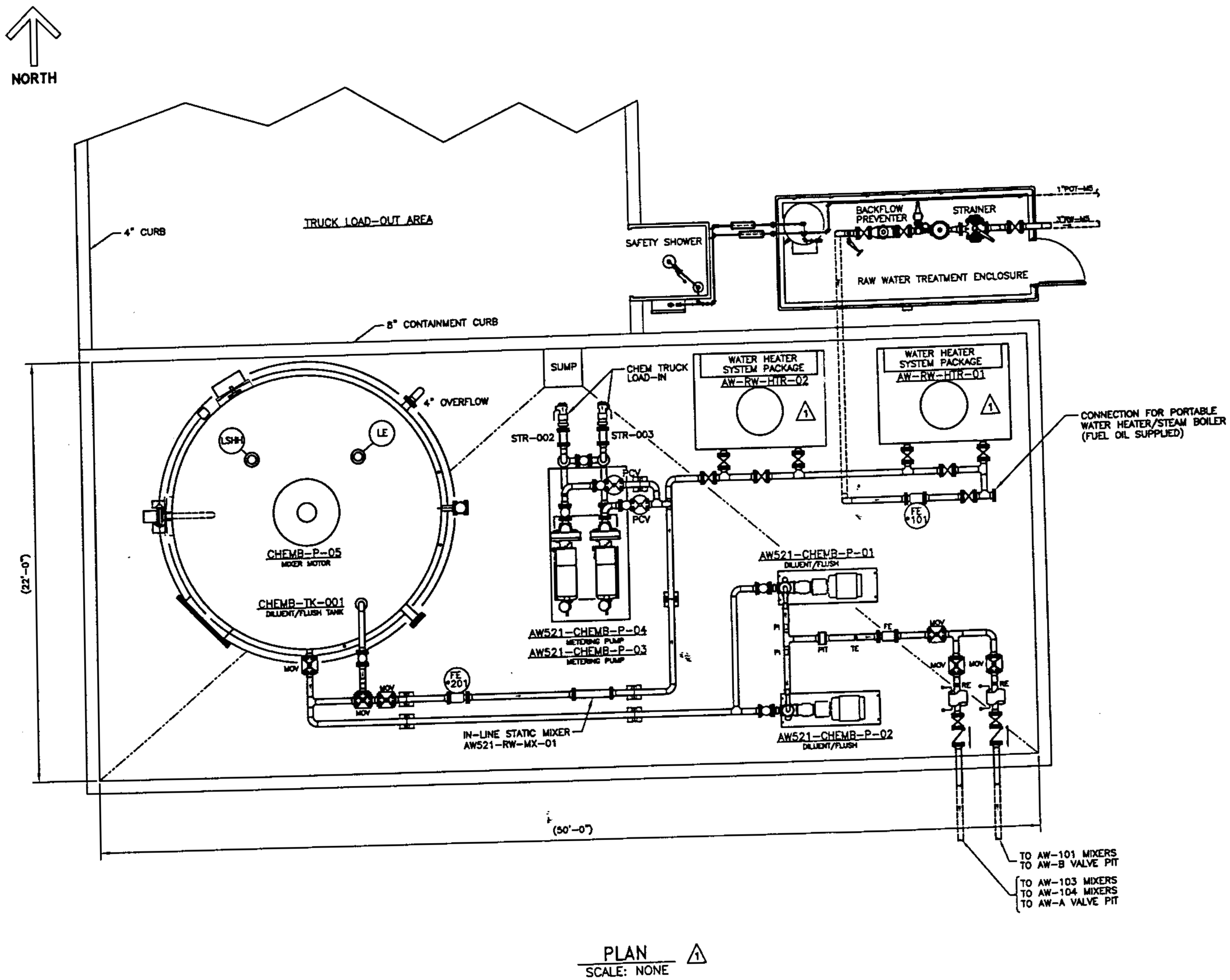
BLDG. 241-AP

FOR
CH2M HILL HANFORD GROUP, INC.

DRAWN	V. HALE
DESIGN	R. LAMOUREUX
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ESW-521-M9 | REV. 1



PLAN
SCALE: NONE

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS:
   15493
   15499
2. SEE ESW-521-P6, SH 1 FOR EQUIPMENT IDENTIFICATION SYSTEM.
3. INSULATE AND HEAT TRACE EXPOSED PIPING AND EQUIPMENT

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5 & 4.6	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

PIPING
DILUENT/FLUSH SYSTEM
PLAN 241-AW

DRAWN	RE WILSON
DESIGN	R. MOSSBRUCKER
CHECKED	
RELEASED	
DATE	

BLDG. 241-AW

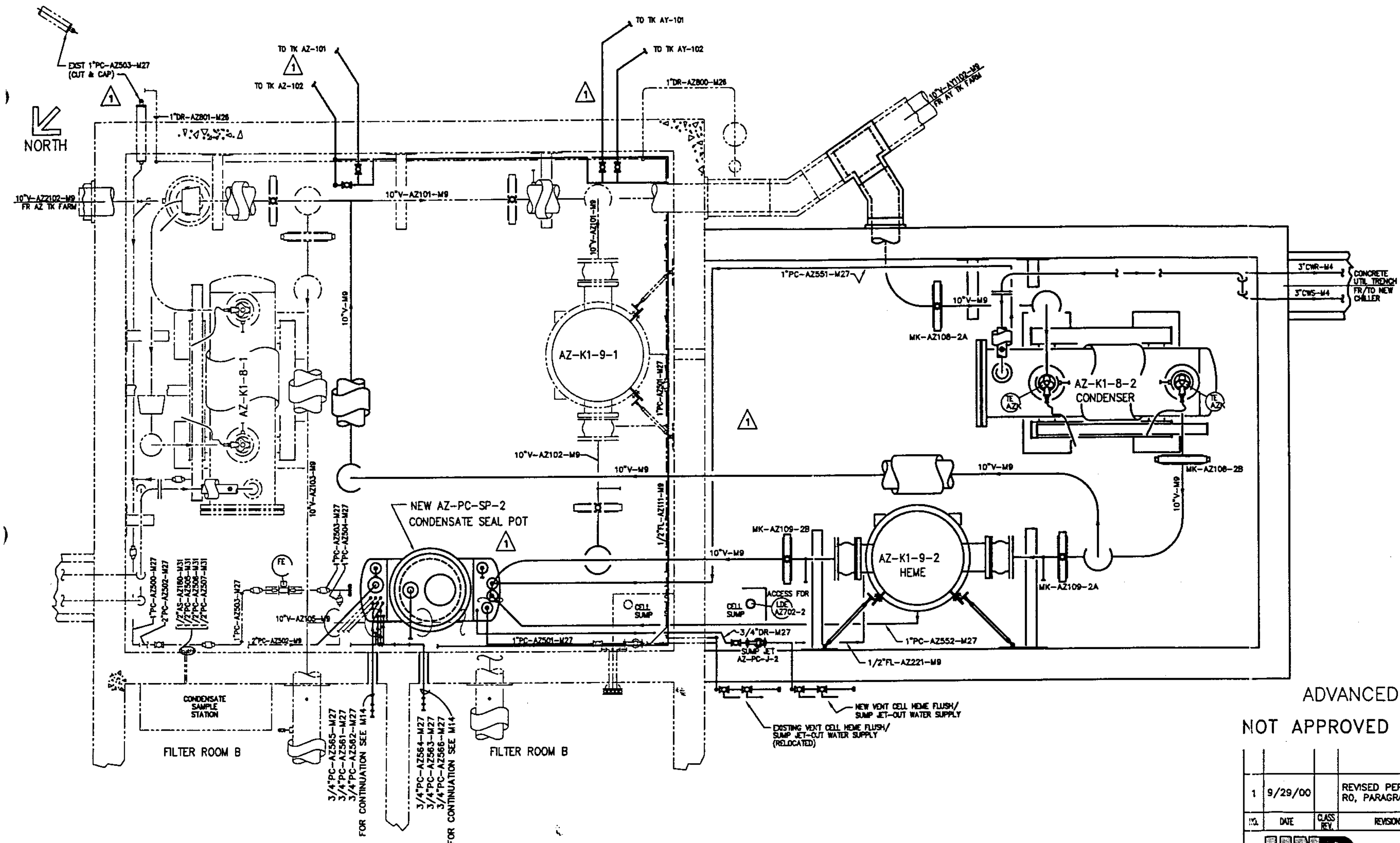
FOR CH2MHILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ESW-521-M12

REV. 1



PLAN
CEILINGS AND COVER BLOCKS NOT SHOWN

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL PLAN
PRIMARY VENT CONDENSATE SYSTEM

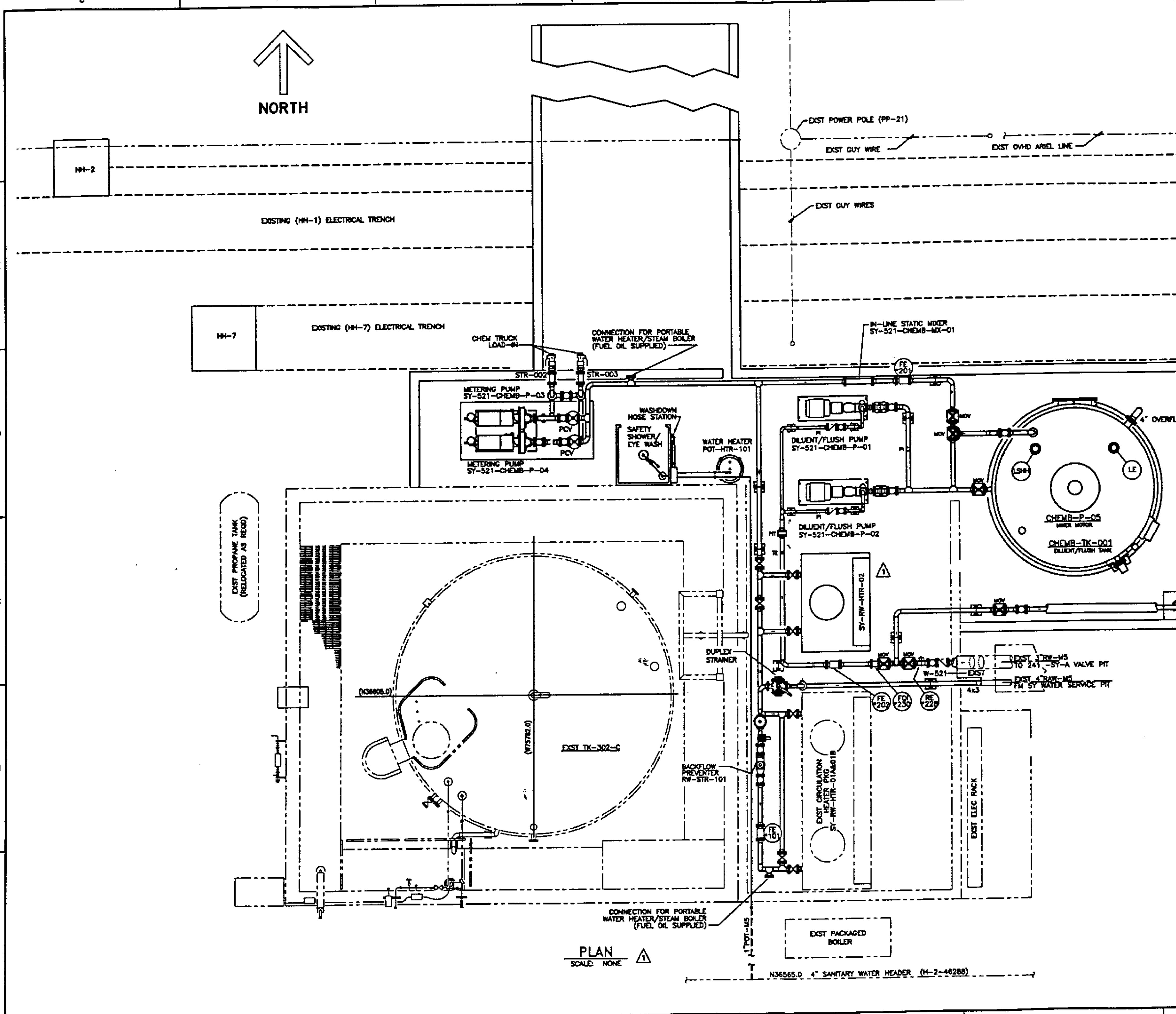
DRAWN
DESIGN
CHECKED
RELEASED
DATE

BLDG. 241-AZ-702
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 1

PROJECT ID 9909202.03
DRAWING NO. ESW-521-M13
REV. 1

RPP-7069, Rev. 0

NOTES:
1. SEE OUTLINE SPECIFICATION SECTIONS:
15493
15490
2. SEE ESW-521-P8, SH 1 FOR EQUIPMENT IDENTIFICATION SYSTEM.



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.5 & 4.6	RM	RM					

HND Holmes & Narver/DMJM | ARES CORPORATION | M&D

PROJECT W-521
WASTE FEED DELIVERY
PIPING
CAUSTIC AND DILUENT SYSTEM
PLAN 241-SY

BLDG. 241-SY

FOR
CH2MHILL HANFORD GROUP, INC.

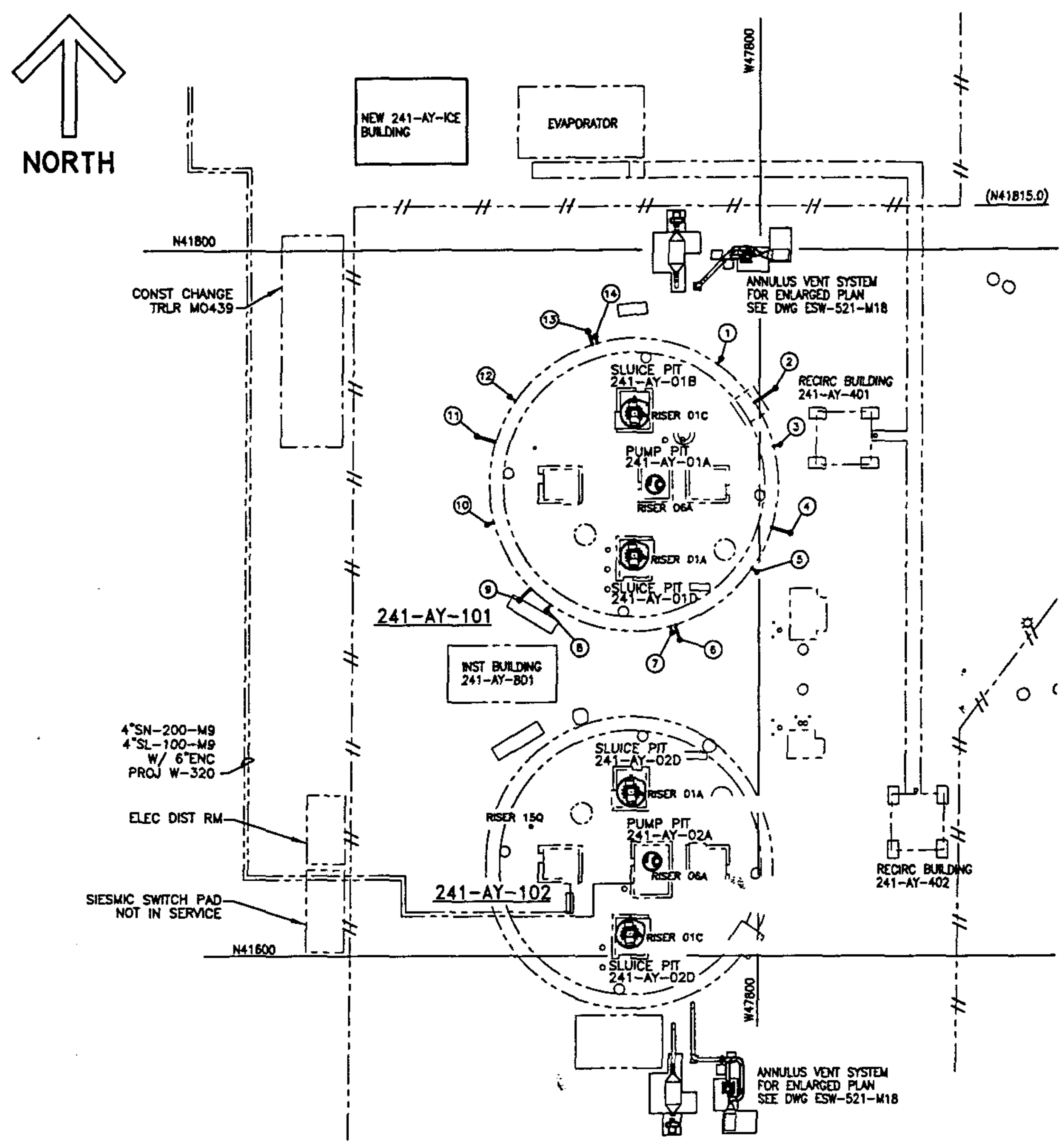
DRAWN	A RES
DESIGN	R LAMOUREUX
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ESW-521-M16

REV. 1



PLAN 241-AY TANK FARM

LEGEND

- - - - - - EXISTING

———— NEW

NOTES:

1. INSTALL NEW ORIFICE PLATE, DRILL TO MATCH PIPE ID. INSTALL NEW BOLTS AND NUTS WITH INSTALLATION OF NEW ORIFICE PLATE.

2. INSTALL NEW BLANK ORIFICE PLATE. INSTALL NEW BOLTS AND NUTS WITH INSTALLATION OF NEW ORIFICE PLATE.

ORIFICE ID	S-SUPPLY E-EXHAUST	PIPE SIZE	ORIFICE PLATE	DEPTH BELOW GRADE
1	S	4"	NOTE 2	12.5'
2	E	4"	NOTE 1	12.5'
3	S	3"	NOTE 1	8'
4	E	4"	NOTE 1	12.5'
5	S	6"	NOTE 2	14'
6	E	4"	NOTE 1	14'
7	S	3"	NOTE 1	14.5'
8	S	6"	NOTE 2	8'
9	E	4"	NOTE 1	13'
10	S	3"	NOTE 1	9'
11	E	4"	NOTE 1	11.5'
12	S	4"	NOTE 2	12.5'
13	E	4"	NOTE 1	13'
14	S	3"	NOTE 1	8'

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, RO, PARAGRAPH 4.3	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
241-AY ANNULUS PLAN
EXCAVATION

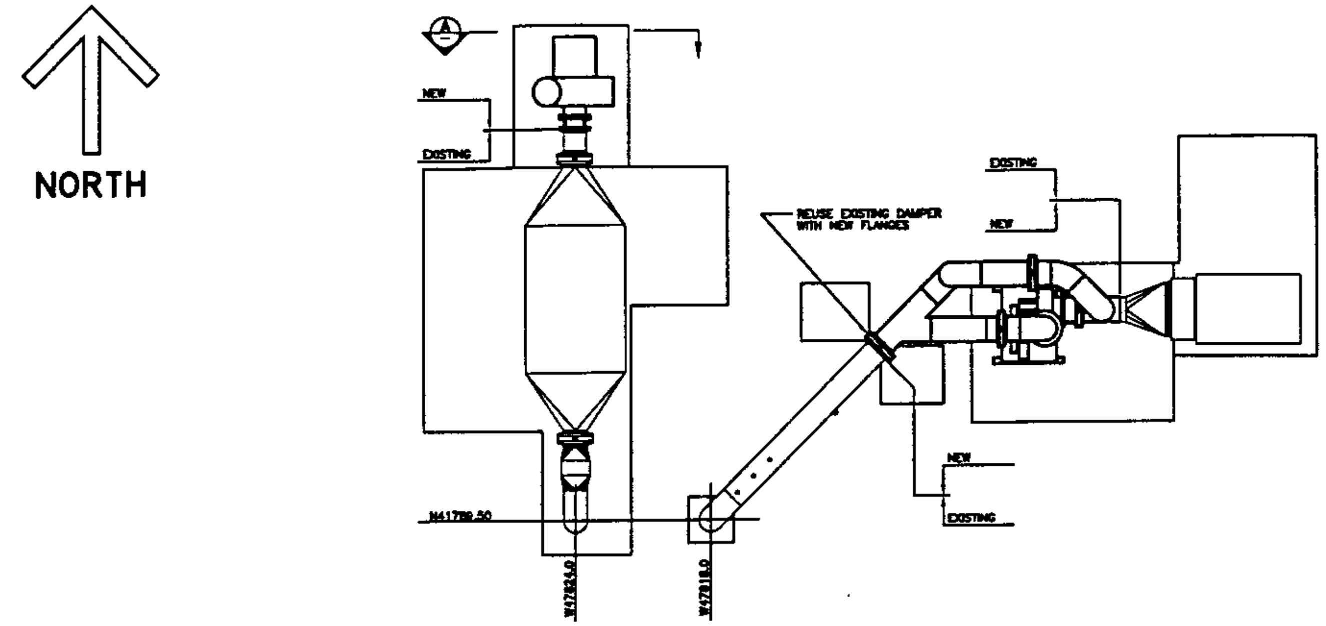
DRAWN / DESIGN / CHECKED / RELEASED / DATE

BLDG. 241-AY

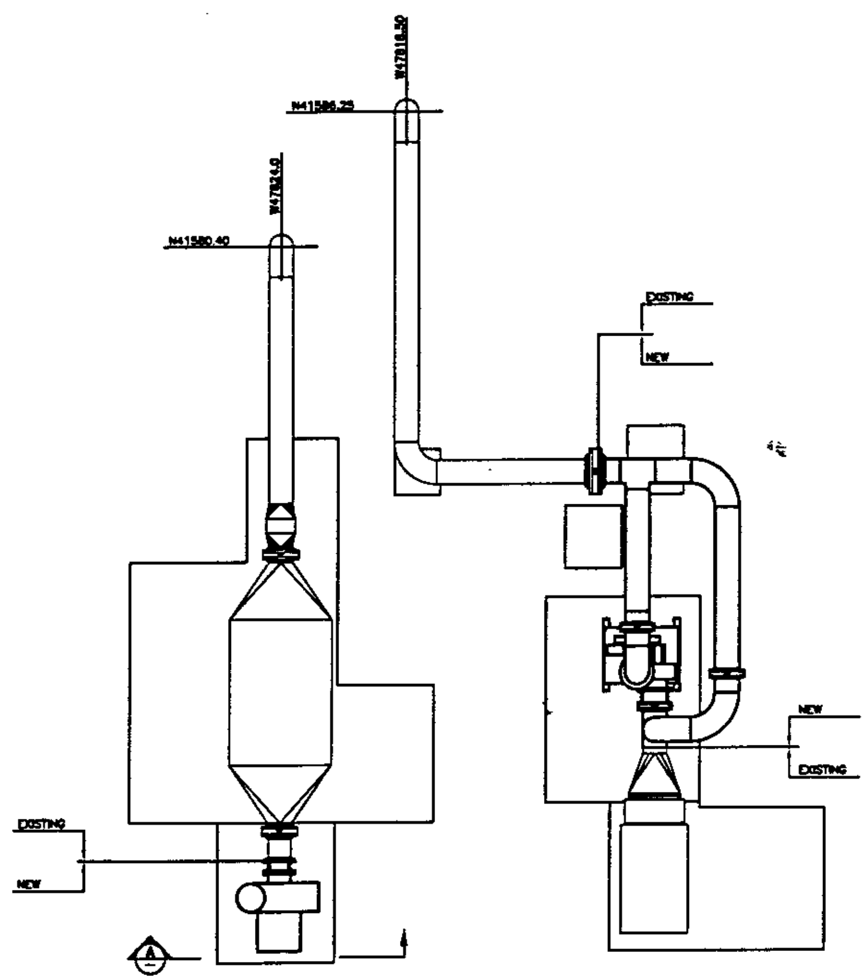
FOR
CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03 | DRAWING NO. ESW-521-M17 | REV. 0



PLAN - AY-101 ANNULUS VENTILATION SUPPLY AND EXHAUST

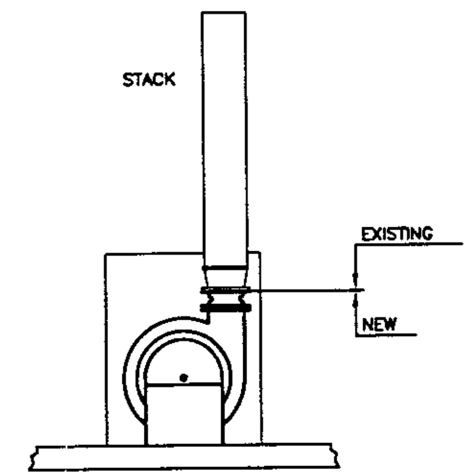


PLAN - AY-102 ANNULUS VENTILATION SUPPLY AND EXHAUST

LEGEND

EXISTING

NEW



SECTION (A/-)
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

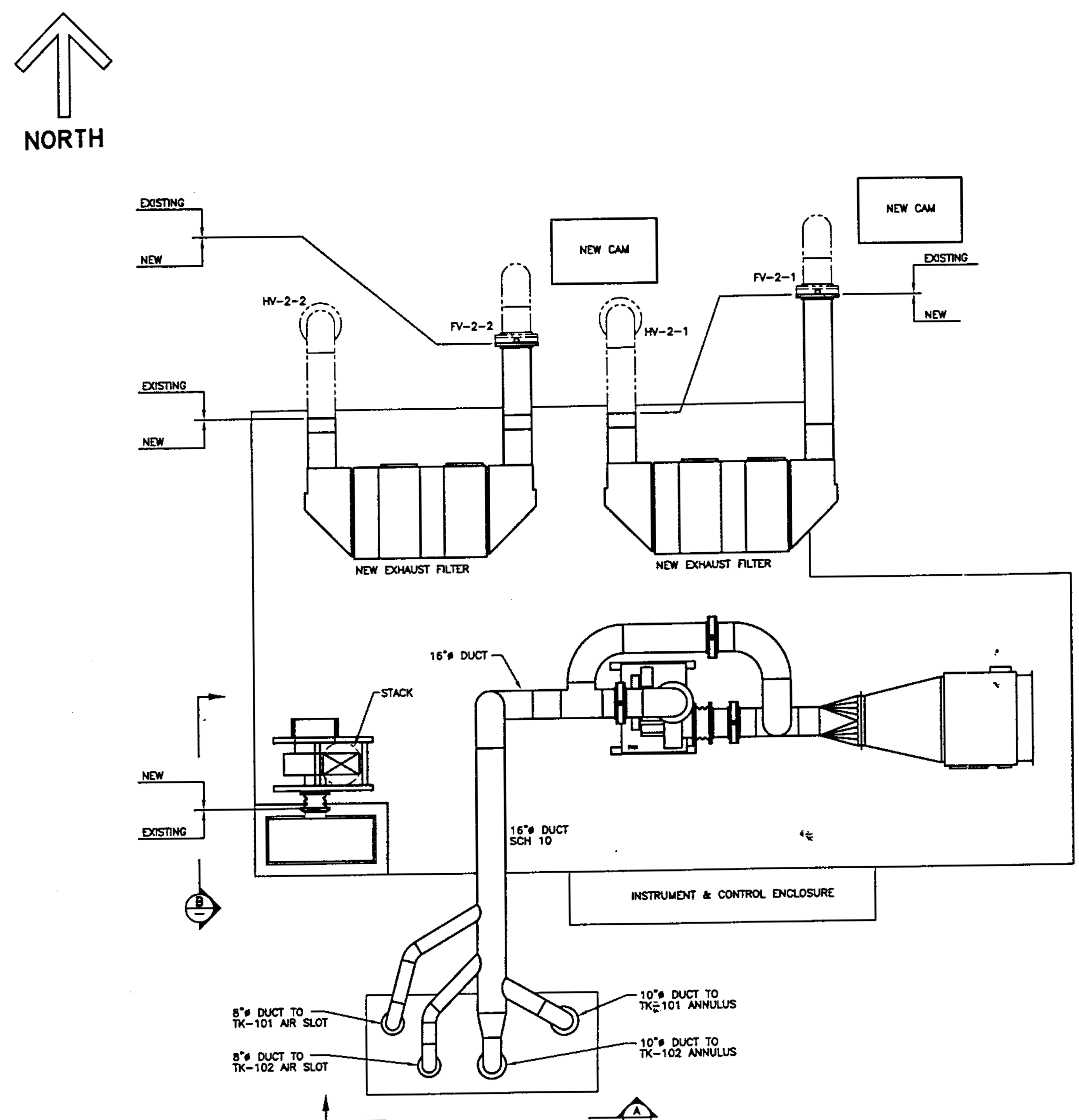
HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
ANNULUS SUPPLY AND EXHAUST PLAN
241-AY TANK FARM

DRAWN	
DESIGN	
CHECKED	
RELEASED	
DATE	

BLDG. 241-AY
FOR CH2M HILL HANFORD GROUP, INC. — SHEET 1 OF 1

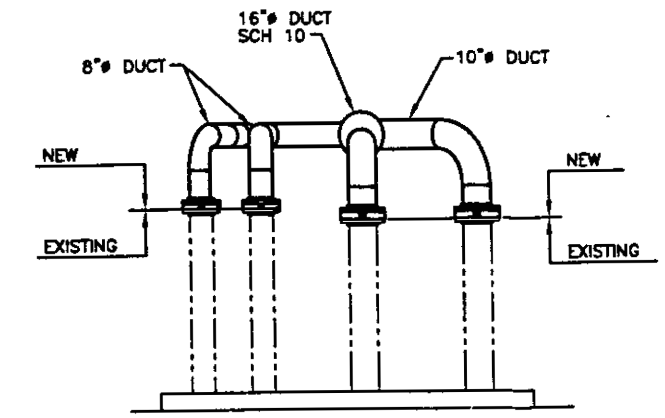
PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-M18	0



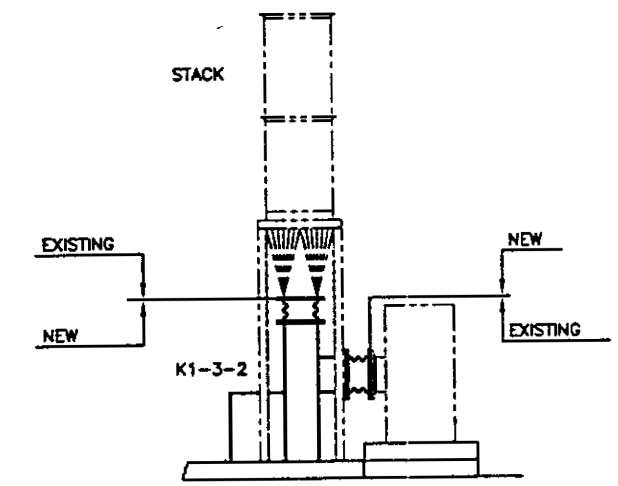
PLAN - AZ ANNULUS VENTILATION SUPPLY AND EXHAUST

LEGEND

- - - - - -	EXISTING
————	NEW



SECTION A
SCALE: NONE



SECTION B
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
ANNULUS SUPPLY AND EXHAUST PLAN
241-AZ TANK FARM

DRAWN / DESIGN / CHECKED / RELEASED / DATE

BLDG. 241-AZ

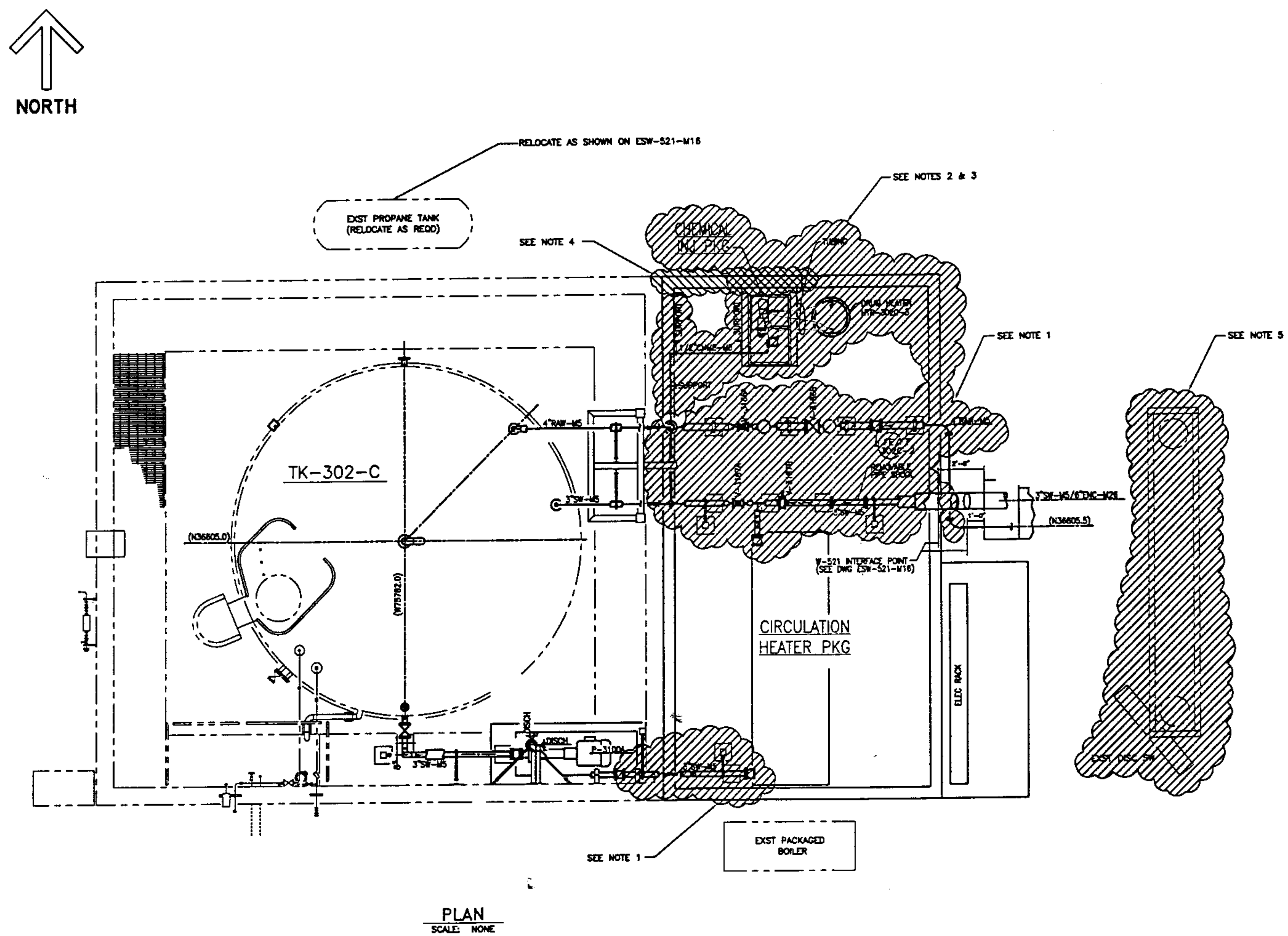
FOR
CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-M19	0

GENERAL NOTES:

1. REMOVE CHMB, RW, & SW PIPING AND ASSOCIATED SUPPORTS AS SHOWN.
2. REMOVE CHEMICAL INJECTION PACKAGE, ASSOCIATED TUBING AND DRUM HEATER.
3. REMOVE CHEMICAL INJECTION PACKAGE SUPPORT PEDESTAL.
4. REMOVE PARTIAL WALL AS INDICATED.
5. REMOVE TRANSFORMER BANK, EQUIPMENT, AND ASSOCIATED POWER POLES.
6. SEAL ALL OPEN PIPE LINES AND/OR CONNECTIONS.



PLAN
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		NEW DRAWING ADDED PER RPP-7069, R0, PARAGRAPH 4.16	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
MECHANICAL
CAUSTIC AND DILUENT SYSTEM
241-SY DEMOLITION PLAN

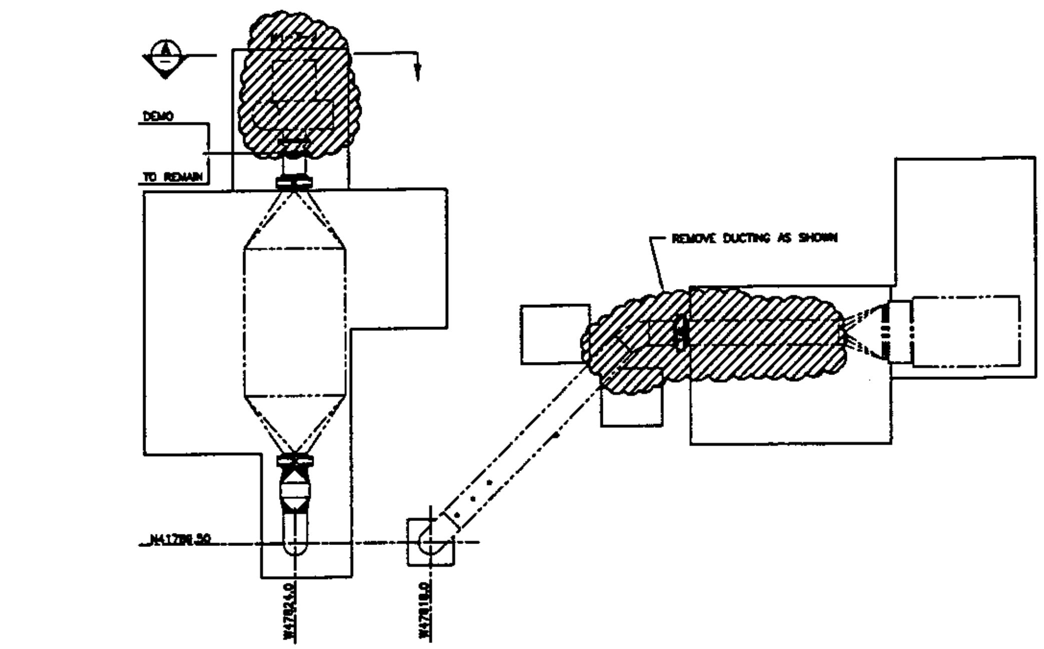
DRAWN	A RES
DESIGN	R LAMOUREUX
CHECKED	
RELEASED	
DATE	

BLDG. 241-SY

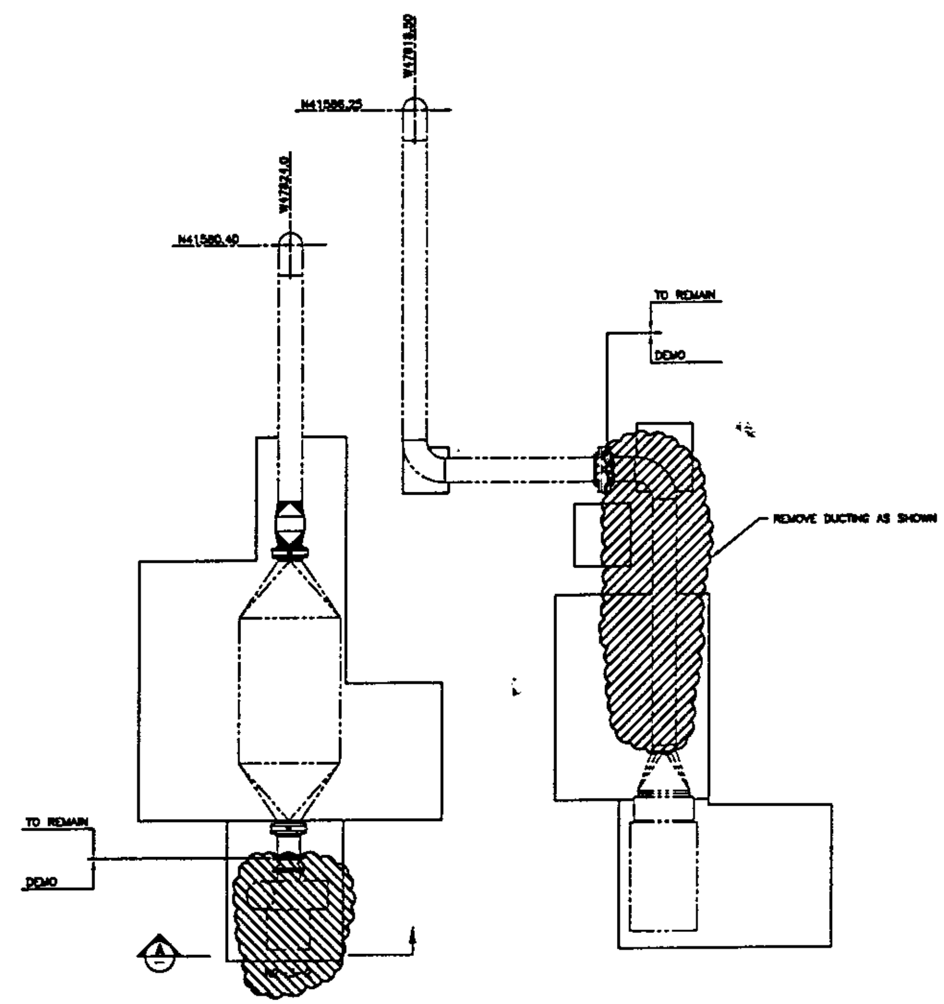
FOR CH2MHILL HANFORD GROUP, INC.

SHEET 1 OF 1

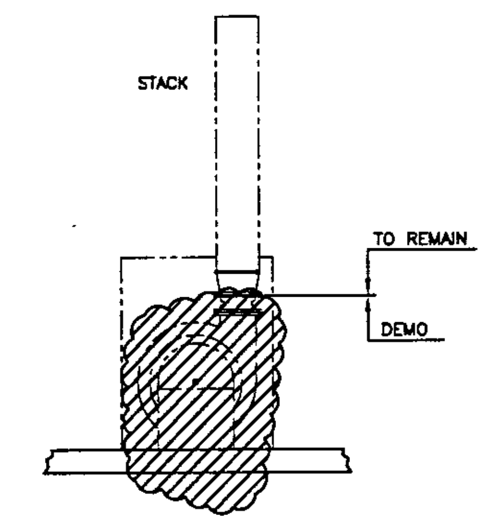
PROJECT ID 9909202.03 | DRAWING NO. ESW-521-M20 | REV. 0



PLAN – AY-101 ANNULUS VENTILATION SUPPLY AND EXHAUST



PLAN – AY-102 ANNULUS VENTILATION SUPPLY AND EXHAUST



SECTION (A)
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

Holmes & Narver/DMJM | ARES CORPORATION | M&D

PROJECT W-521
WASTE FEED DELIVERY

MECHANICAL
ANNULUS SUPPLY AND EXHAUST
241-AY DEMOLITION PLAN

DRAWN
DESIGN
CHECKED
RELEASED
DATE

BLDG. 241-AY

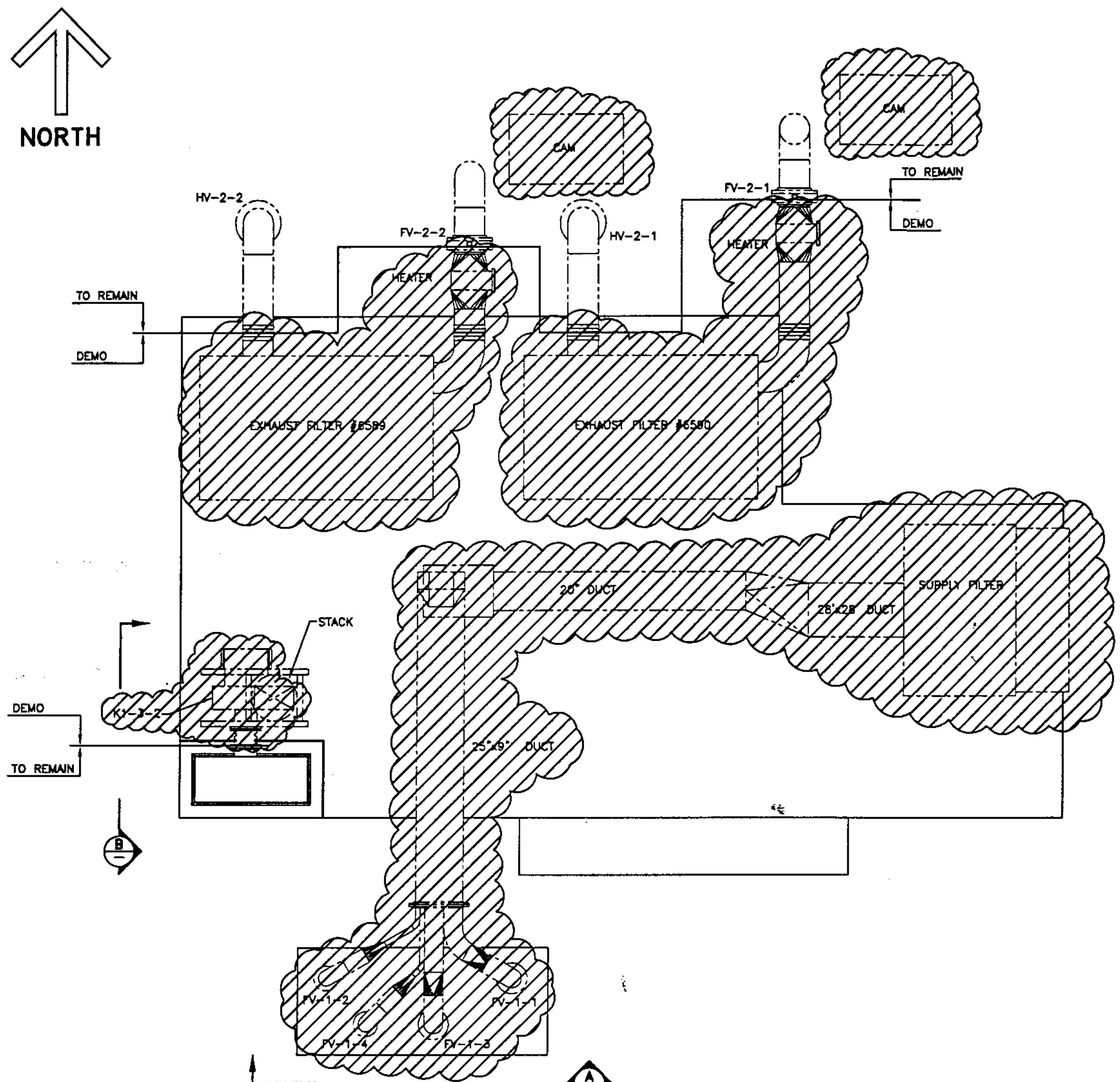
FOR
CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

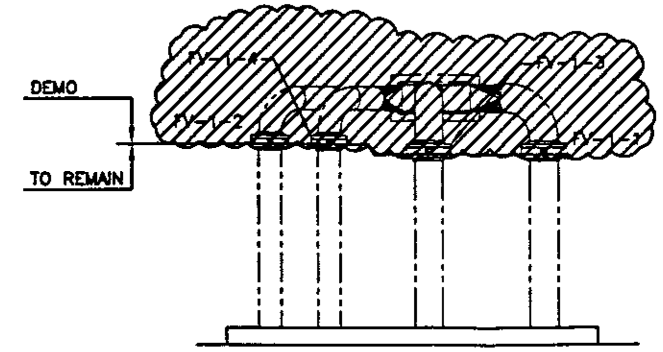
PROJECT ID 9909202.03

DRAWING NO. ESW-521-M21

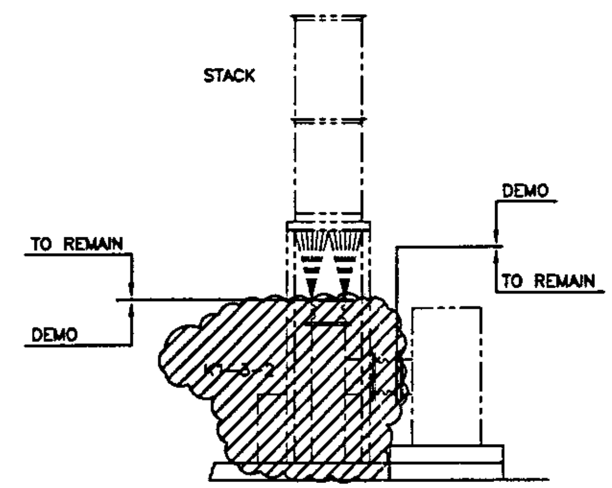
REV. 0



PLAN – AZ ANNULUS VENTILATION SUPPLY AND EXHAUST



SECTION (A)
SCALE: NONE



SECTION (B)
SCALE: NONE

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

HNFD Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY

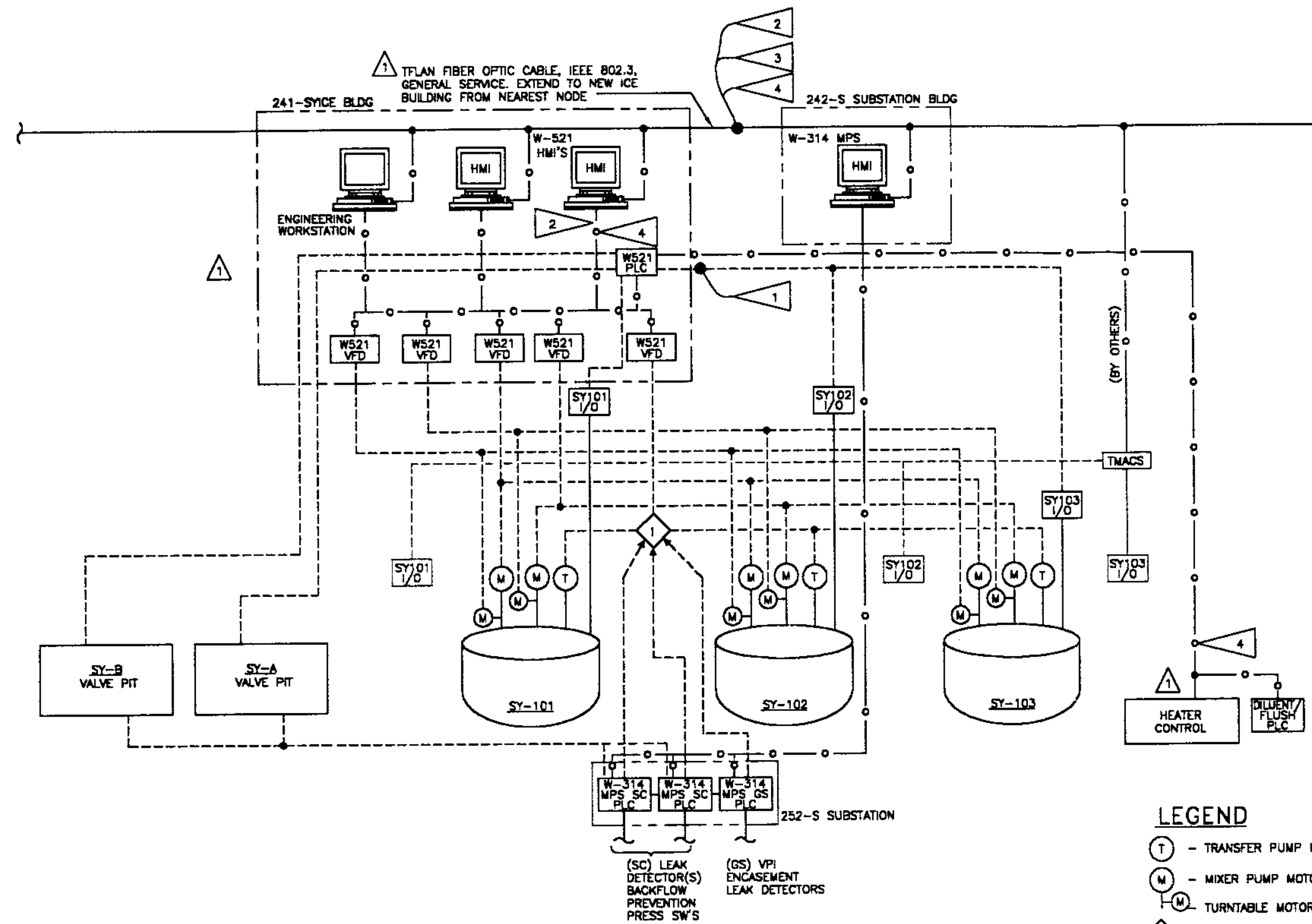
MECHANICAL
ANNULUS SUPPLY AND EXHAUST
241-AZ DEMOLITION PLAN

BLDG. 241-AZ

DRAWN / DESIGN / CHECKED / RELEASED / DATE

FOR CH2M HILL HANFORD GROUP, INC. — SHEET 1 OF 1

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-M22 — REV. 0



NOTES:

1. TANK FARM LAN (TFLAN) BY OTHERS.
2. TMACS CONNECTION TO TFLAN BY OTHERS.
3. THE RETRIEVAL CONTROL SYSTEM BLOCK DIAGRAM DEPICTS THE GENERAL ARCHITECTURE OF THE W-521 RCS. THE DIAGRAM SHOWS THE GENERAL FLOW OF DATA AND INTERFACES BETWEEN EXISTING INSTRUMENTS, EXISTING CONTROL SYSTEMS, AND FUTURE CONTROL SYSTEMS PROVIDED BY THIS PROJECT AND OTHERS.
4. AT THIS STAGE OF THE DESIGN PROCESS, THE INFORMATION CONTAINED IN THE DATA BLOCKS IS CONCEPTUAL. AS THE DESIGN PROGRESSES, IT IS ANTICIPATED THAT THE SIZE OF DATA BLOCKS WILL DOUBLE.
5. ALL SAFETY SIGNIFICANT INPUTS AND OUTPUTS WILL BE HARDWIRED TO THE NEW SAFETY SIGNIFICANT PLC BASED MPS SYSTEM.
6. TFLAN WILL BE USED TO PASS GENERAL SERVICE DATA BETWEEN THE W-521 RCS AND THE MPS GENERAL SERVICE PLC.
7. FIVE TEMPERATURE TREES, THAT ARE CAPABLE OF WITHSTANDING MIXER PUMP FORCES, WILL BE INSTALLED IN THE AGING WASTE TANKS THAT FALL UNDER THE SCOPE OF THIS PROJECT. ONE TEMPERATURE TREE WILL BE INSTALLED IN ALL OTHER TANKS THAT FALL UNDER THE SCOPE OF THIS PROJECT.
8. SEE OUTLINE SPECIFICATION SECTION 13440.
9. TFLAN WILL BE UTILIZED TO SEND DILUENT AND FLUSH DATA BETWEEN LOCAL-REMOTE HMI'S.

DATA BLOCK 1

INPUTS:

- TRANSFER PUMP VARIABLE SUCTION POSITION
- TRANSFER PUMP DISCHARGE FLOW RATE
- TRANSFER PUMP DISCHARGE PRESSURE
- TRANSFER PUMP DISCHARGE DENSITY
- TRANSFER PUMP DISCHARGE TEMPERATURE
- TRANSFER MOTOR WINDING TEMPERATURE
- PRESSURE SWITCH, INDICATION OF RELIEF EVENT
- PRESSURE SWITCH, INDICATION OF BACKFLOW CONDITION
- POSITION OF WASTE FLOW CONTROL VALVE
- ENCASEMENT LEAK DETECTION
- TRANSFER PUMP MANUAL TRANSFER SWITCH POSITION
- MIXER PUMP DISCHARGE PRESSURE (QT. 2)
- MIXER PUMP BEARING TEMPERATURE (QT. 2)
- MIXER PUMP MOTOR WINDING TEMPERATURE
- MIXER PUMP VIBRATION (QT. 2)
- MIXER PUMP MANUAL TRANSFER SWITCH POSITION
- MIXER PUMP TURNTABLE MANUAL TRANSFER SWITCH POSITION
- MIXER PUMP TURNTABLE POSITION SWITCHES (QT. 4)
- MIXER PUMP TURNTABLE POSITION

(EXISTING TANK I/O)

- TANK LEVEL
- TANK HIGH HYDROGEN LEVEL, NOT INTERLOCKED (WHERE EXISTING)
- STACK HIGH RADIATION MONITOR ALARM
- HEPA LOW DIFFERENTIAL PRESSURE ALARM
- CAM INTERLOCK TO SHUTDOWN WASTE DISTURBING OPERATIONS
- TANK DOME SPACE PRESSURE
- ANNULUS VENTILATION FAILURE
- INSULATING CONCRETE AND TANK STRUCTURE THERMOCOUPLES

(TANK I/O)

- TANK TEMPERATURE (QT. 18 PER TEMPERATURE PROBE)
- CAMERA PURGE FAIL
- NORMAL POWER FAILURE,
- IN-TANK LEVEL/DENSITY TBD

OUTPUTS:

- POSITION VALVES FOR VARIOUS 'MODES OF OPERATION'
- POSITION FLOW CONTROL VALVE
- POSITION TRANSFER PUMP WINCH

LEGEND

T - TRANSFER PUMP MOTOR
M - MIXER PUMP MOTOR
M - TURNTABLE MOTOR
I - INTERLOCK
\# - DATA BLOCK NUMBER (SEE DATA BLOCK TABLES)
—o— - DATA LINK
----- ELECTRICAL POWER OR SIGNAL
TFLAN - TANK FARM LOCAL AREA NETWORK (BY OTHERS)
HMI - HUMAN MACHINE INTERFACE
PLC - PROGRAMMABLE LOGIC CONTROLLER
VPI - VALVE POSITION INDICATION
MPS - MASTER PUMP SHUTDOWN
I/O - INSTRUMENTATION/CONTROLS INPUTS & OUTPUTS
PC - PRIVATE CONTRACTOR
TMACS - TANK MONITOR AND CONTROL SYSTEM
ICE - INSTRUMENTATION CONTROL AND ELECTRICAL
SC - SAFETY CLASS
GS - GENERAL SERVICE
W-521
W-314
W-211
PRIVATE CONTRACTOR (PC)
EXISTING

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

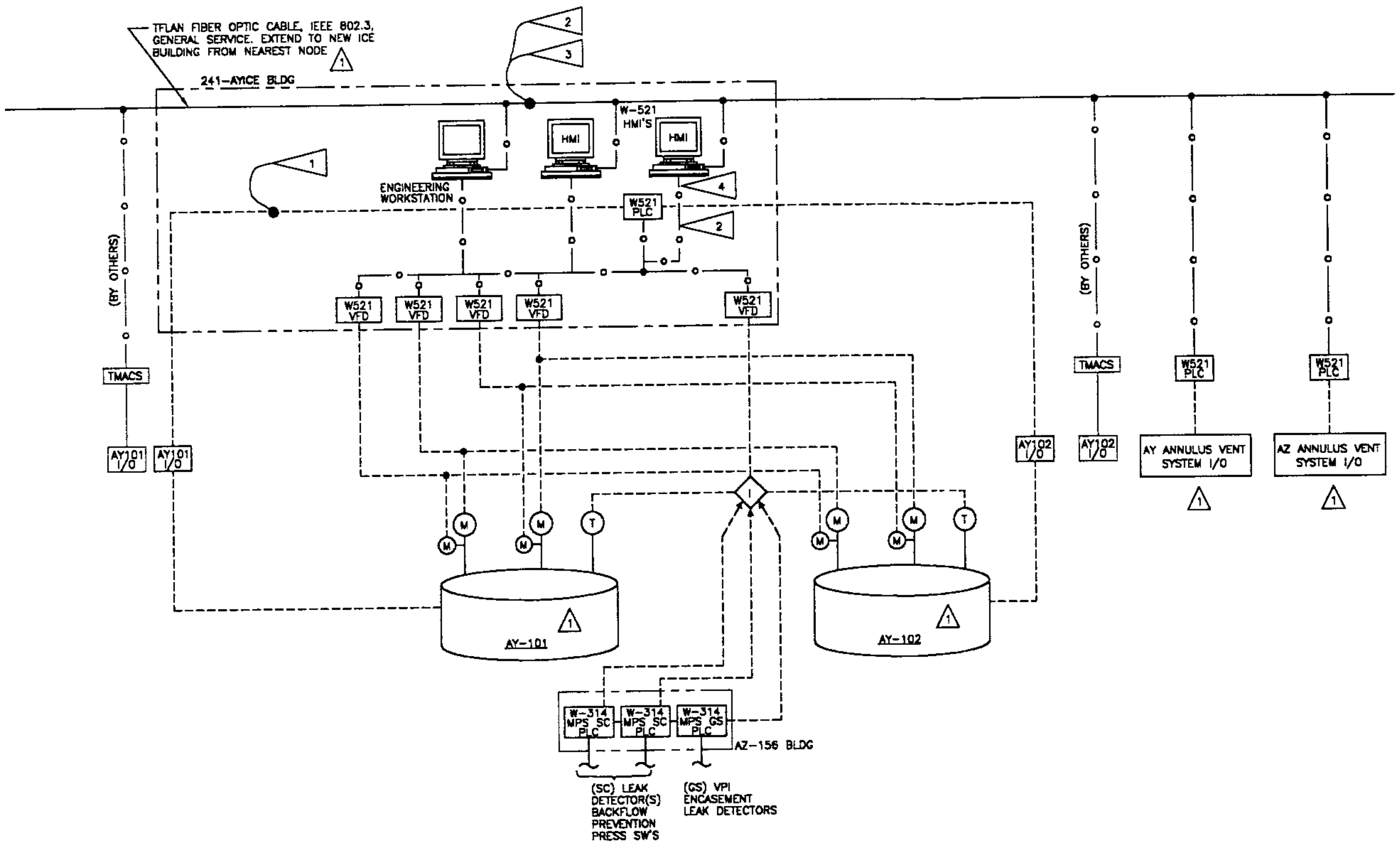
NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.5 & 4.13 & 4.14	RM	RM					

Holmes & Narver/DMJM
ARES CORPORATION
M&D

PROJECT W-521
WASTE FEED DELIVERY
INSTRUMENTATION
RETRIEVAL CONTROL SYSTEM
SY-101,-102, &-103 BLOCK DIAGRAM

DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

BLDG. 241-SY
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 3
PROJECT ID 9909202.03
DRAWING NO. ESW-521-I&C1
REV. 1



NOTE:
1. SEE SHEET 1 FOR NOTES AND LEGEND.

DATA BLOCK 2

INPUTS:
- TRANSFER PUMP VARIABLE SUCTION POSITION
- TRANSFER PUMP DISCHARGE FLOW RATE
- TRANSFER PUMP DISCHARGE PRESSURE
- TRANSFER PUMP DISCHARGE DENSITY
- TRANSFER PUMP DISCHARGE TEMPERATURE
- TRANSFER MOTOR WINDING TEMPERATURE
- VALVE POSITION SWITCHES
- PRESSURE SWITCH, INDICATION OF RELIEF EVENT
- PRESSURE SWITCH, INDICATION OF BACKFLOW CONDITION
- POSITION OF WASTE FLOW CONTROL VALVE
- ENCASEMENT LEAK DETECTION
- TRANSFER PUMP MANUAL TRANSFER SWITCH POSITION
- TRANSFER PUMP SPEED INDICATION
- TRANSFER PUMP MOTOR AMPS
- LOCAL/REMOTE MODE
- ON/OFF STATUS
- MIXER PUMP DISCHARGE PRESSURE (QT. 2)
- MIXER PUMP BEARING TEMPERATURE (QT. 2)
- MIXER PUMP MOTOR TEMPERATURE
- MIXER PUMP VIBRATION (QT. 2)
- MIXER PUMP MANUAL TRANSFER SWITCH POSITION
- MIXER PUMP TURNTABLE MANUAL TRANSFER SWITCH POSITION
- MIXER PUMP TURNTABLE POSITION SWITCHES (QT. 4)
- MIXER PUMP TURNTABLE POSITION
- MIXER PUMP TURNTABLE DIRECTION CCW/CW
- MIXER PUMP TURNTABLE SPEED INDICATION
- MIXER PUMP SPEED INDICATION
- MIXER PUMP MOTOR AMPERES
- LOCAL/REMOTE MODE
- ON/OFF STATUS

(EXISTING TANK I/O)

- TANK LEVEL
- TANK HIGH HYDROGEN LEVEL, NOT INTERLOCKED (WHERE EXISTING)
- STACK HIGH RADIATION MONITOR ALARM
- HEPA LOW DIFFERENTIAL PRESSURE ALARM
- CAM INTERLOCK TO SHUTDOWN WASTE DISTRIBUTING OPERATIONS
- TANK DOME SPACE PRESSURE
- ANNULUS VENTILATION FAILURE
- INSULATING CONCRETE AND TANK STRUCTURE THERMOCOUPLES 1

(TANK I/O)

- TANK TEMPERATURE (QT. 18 PER TEMPERATURE PROBE)
- CAMERA PURGE FAIL
- NORMAL POWER FAILURE
- IN-TANK LEVEL/DENSITY TBD

OUTPUTS:

(COMMANDS – OUTPUTS – TRANSFER PUMP)

- POSITION VALVES FOR VARIOUS 'MODES OF OPERATION'
- POSITION FLOW CONTROL VALVE
- POSITION TRANSFER PUMP WINCH
- TRANSFER PUMP START
- TRANSFER PUMP STOP
- TRANSFER PUMP SPEED

(COMMANDS – OUTPUTS – MIXER PUMP)

- MIXER PUMP START
- MIXER PUMP STOP
- MIXER PUMP SPEED
- MIXER PUMP ROTATIONAL SPEED
- MIXER PUMP CCW/CW COMMAND

(PLC TO VFD DATA TRANSFER)

- START
- STOP
- DIRECTION (APPLICABLE TO TURNTABLE DRIVE ONLY)
- SPEED COMMAND
- FAULT RESET

(VFD TO PLC DATA TRANSFER)

- FREQUENCY
- MOTOR CURRENT
- FAULT CODE
- CALCULATED TORQUE
- CALCULATED MOTOR SPEED
- CALCULATED MOTOR POWER

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.3, 4.7, 4.13 & 4.14	RM	RM					

HMD Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
INSTRUMENTATION
RETRIEVAL CONTROL SYSTEM
AY & AZ BLOCK DIAGRAM
BLDG. 241-AY & AZ

DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

FOR CH2M HILL HANFORD GROUP, INC.

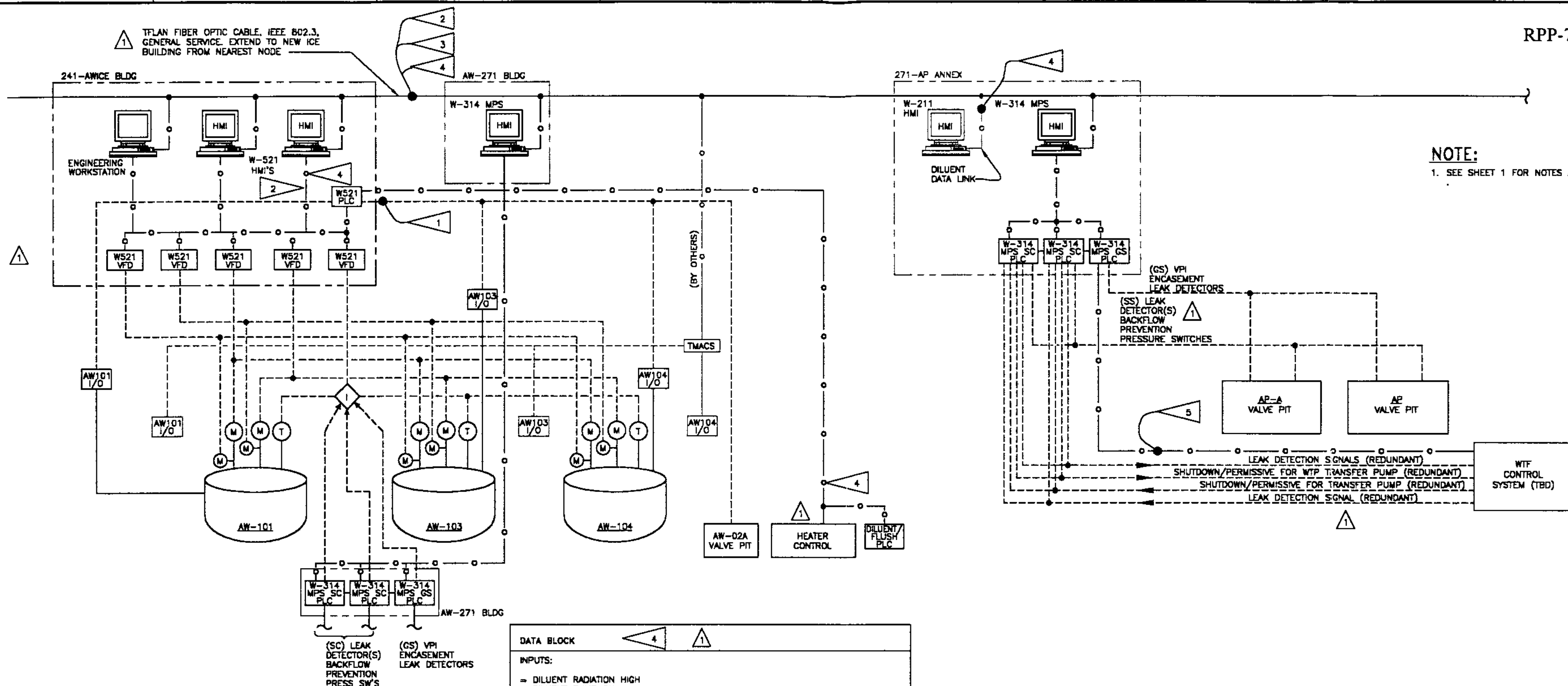
SHEET 2 OF 3

PROJECT ID 9909202.03

DRAWING NO. ESW-521-I&C1

REV. 1

RPP-7069, Rev. 0



NOTE:

1. SEE SHEET 1 FOR NOTES AND LEGEND.

DATA BLOCK 3

INPUTS:

- PERMISSIVE TO START TRANSFER PUMP
- STATUS OF LEAK DETECTORS
- STATUS OF BACKFLOW PREVENTION PRESSURE SWITCHES

OUTPUTS:

- VALVE POSITION
- NON-SAFETY CLASS LEAK DETECTOR ALARMS
- TRANSFER PUMP STATUS
- WASTE TANK LEVEL
- PROCESS WASTE FLOW RATE
- DILUENT FLOW RATE

DATA BLOCK 4 1

INPUTS:

- DILUENT RADIATION HIGH
- DILUENT PUMP ON
- DILUENT PUMP OFF
- DILUENT PUMP SPEED
- DILUENT PUMP MOTOR CURRENT
- DILUENT PUMP DISCHARGE PRESSURE
- DILUENT PUMP DISCHARGE FLOWRATE
- DILUENT PUMP DISCHARGE TEMPERATURE
- DILUENT VALVE POSITION SWITCHES (OPEN/CLOSE OR A,B,C)
- DILUENT FLOW VALVE POSITION
- DILUENT TANK LEVEL
- DILUENT TANK LEVEL SWITCH HIGH
- DILUENT TANK LEVEL SWITCH LOW
- DILUENT TANK TEMPERATURE
- DILUENT TANK CONDUCTIVITY
- CHEMICAL METERING PUMP STATUS
- CHEMICAL METERING PUMP FLOWRATE
- SUMP LEVEL SWITCH HIGH
- RAW WATER RADIATION HIGH
- RAW WATER PRESSURE HIGH
- RAW WATER STRAINER DIFF PRESS HIGH
- RAW WATER FILTER 75 micron DIFF PRESS HIGH
- RAW WATER FILTER 5 micron DIFF PRESS HIGH
- RAW WATER PRESSURE HIGH
- RAW WATER FLOW
- FLOW CONTROL PRESSURE
- RAW WATER FLOW TOTALIZER INDICATION
- HEATED RAW WATER FLOWRATE
- HEATED RAW WATER VALVE POSITION
- RAW WATER FLOW VALVE POSITION
- HEATER STATUS
- HEATER INPUT WATER TEMPERATURE
- HEATER OUTPUT WATER TEMPERATURE
- HEATER FAULT I.E. 'LOW WATER FLOW'

OUTPUTS:

- DISCRETE VALVE POSITION (OPEN/CLOSE OR A,B,C)
- DILUENT FLOW CONTROL VALVE POSITION
- DILUENT PUMP SPEED
- DILUENT MIXER MOTOR START/STOP
- METERING PUMP FLOW SET-POINT
- HEATED WATER FLOW CONTROL VALVE
- HEATER TEMPERATURE SET-POINT

DATA BLOCK 5 1

WTF TO RPP

- TANK LEVELS
- VALVE POSITIONS
- FAULT CODE
- VOLUME CALCULATION
- PUMP STATUS
- FLUSH TANK LEVEL

RPP TO WTF

- TRANSFER PUMP STATUS
- WASTE TEMPERATURE
- TANK LEVELS
- DILUENT PUMP STATUS
- DILUENT FLOW
- WASTE FLOW

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5 & 4.13; CHANGED BNFL TO WTF	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

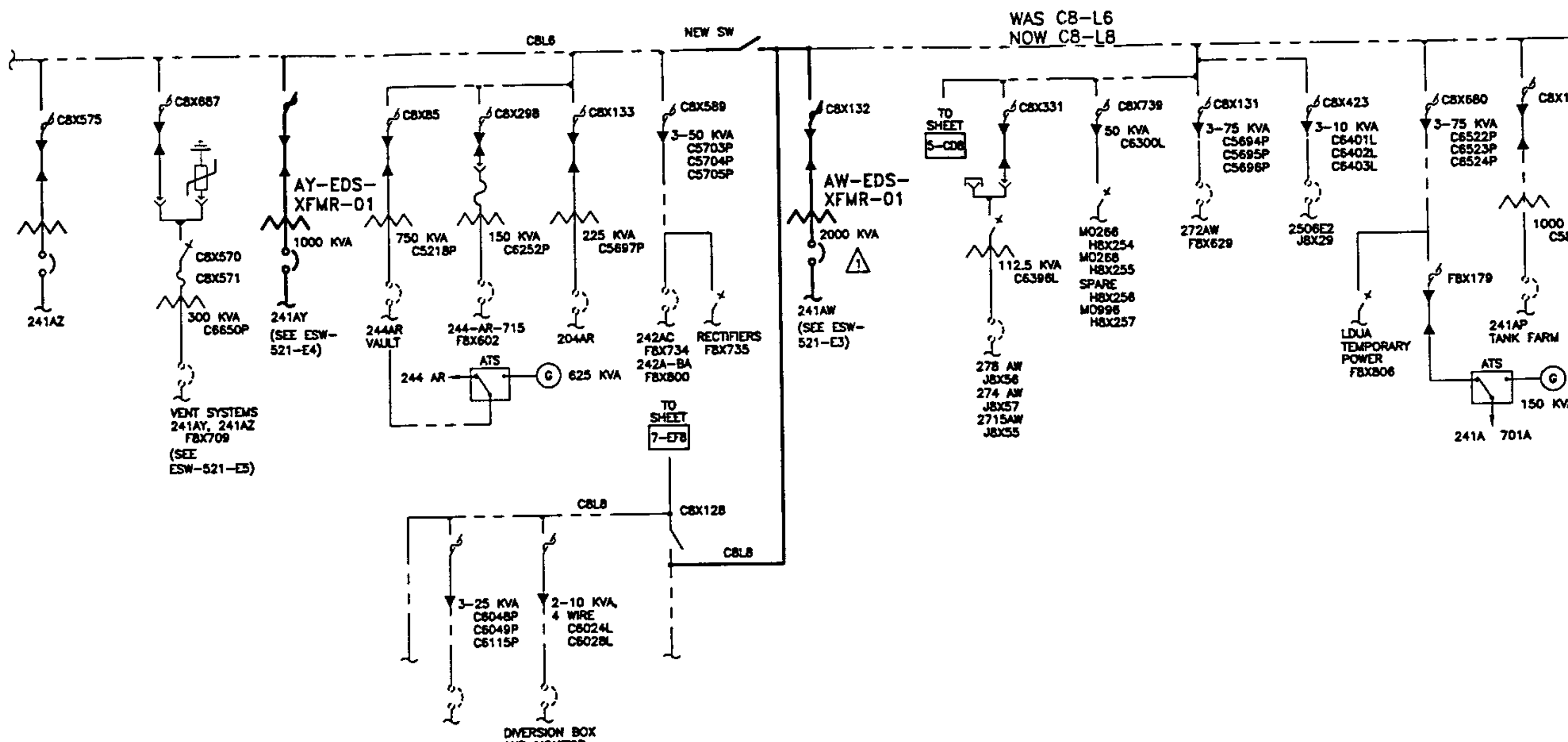
PROJECT W-521
WASTE FEED DELIVERY
INSTRUMENTATION
RETRIEVAL CONT SYS AW-101,102,103,104 & AP,AP-A VALVE PITS BLOCK DIAGRAM
BLDG. 241-AW, -AP

DRAWN	K.S. HALE
DESIGN	M. GARCIA
CHECKED	
RELEASED	
DATE	

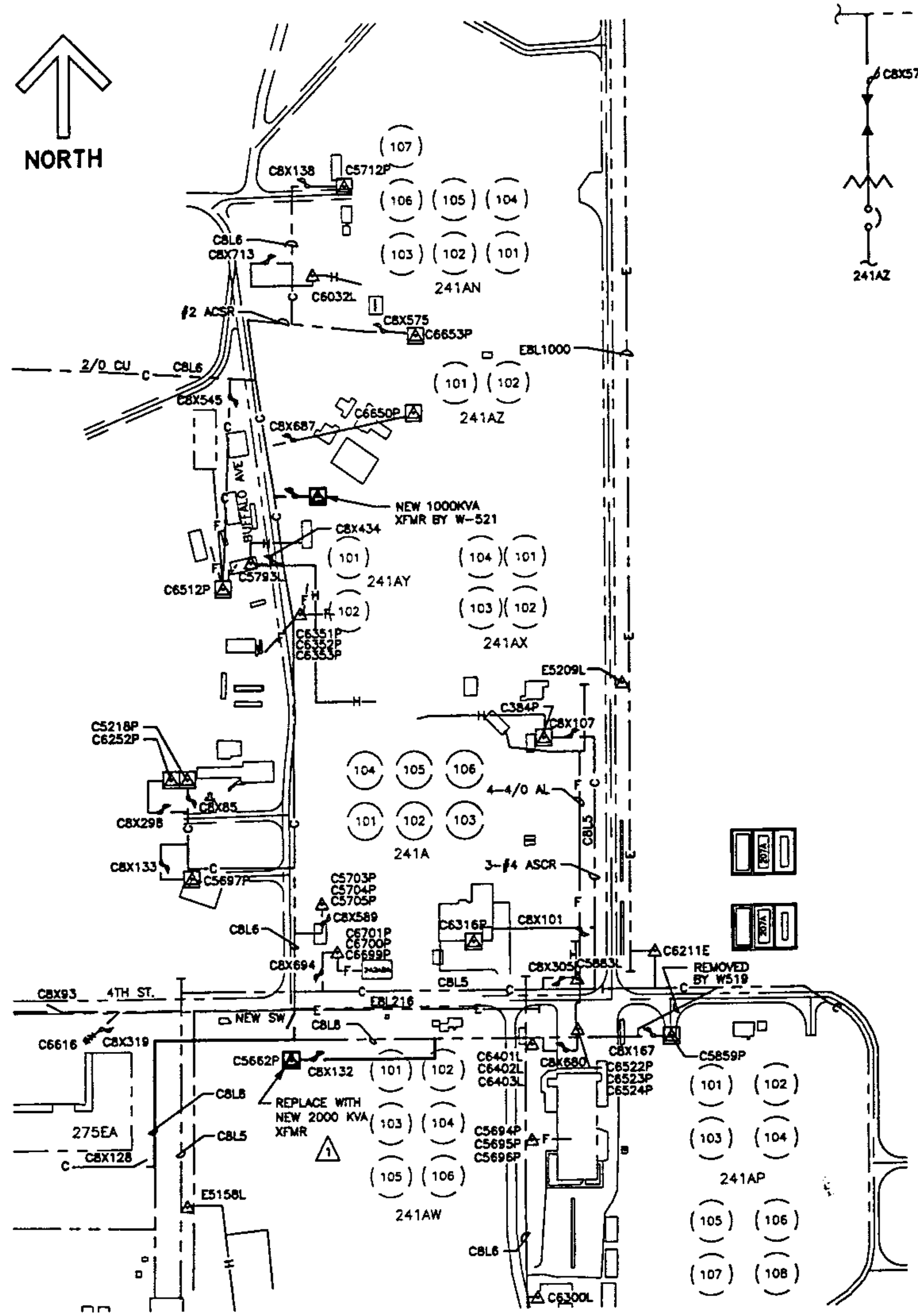
FOR CH2M HILL HANFORD GROUP, INC.

SHEET 3 OF 3

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-I&C1	1



200E PARTIAL 13.8KV ONE LINE DIAGRAM



200E PARTIAL PLAN

SCALE: NONE

LEGEND

△	PAD MOUNTED TRANSFORMER
	TRANSFORMER
	CIRCUIT BREAKER
	13.8KV SWITCH & FUSE
	13.8KV SWITCH
	FUSE - HOOK STICK OPERATED
LA 3	LIGHTNING ARRESTERS (3-REQD)
XXXAF XXXAT	CIRCUIT BREAKER WITH SENSORS: XXXAF AMP FRAME XXXAT AMP TRIP
TS	TEST SWITCH
PWR METER	POWER METER
SS METER	SOLID STATE METER
▲	LOAD BREAK ELBOWS OR STRESS CONES
	MANUAL TRANSFER SWITCH
AF AT	AMP FRAME AMP TRIP
SST XXXAS XXXAP	CIRCUIT BREAKER WITH SENSOR AND PLUG XXXAS AMP SENSOR RATING XXXAP AMP PLUG RATING
SST	SOLID STATE TRIP UNIT LONG TIME PICKUP INSTANTANEOUS PICKUP INTERCHANGEABLE TRIP PLUG
ITX	ISOLATION TRANSFORMER
TBX	TERMINAL BOX
VFD	VARIABLE SPEED DRIVE
	MINI-POWER CENTER, NEMA 3R SIZE AS SHOWN
- - - -	EXISTING EQUIPMENT
———	NEW WORK BY W-521
—C—	13.8KV POLE LINE
—F—	480V

NOTE:

1. SEE OUTLINE SPECIFICATION SECTION: 16400

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5	RM	RM					

HNHD Holmes & Narver/DMJM | ARES CORPORATION | Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
13.8KV DISTRIBUTION LAYOUT/ONE LINE

BLDG. 2503E

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN	KARI S. HALE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID 9909202.03

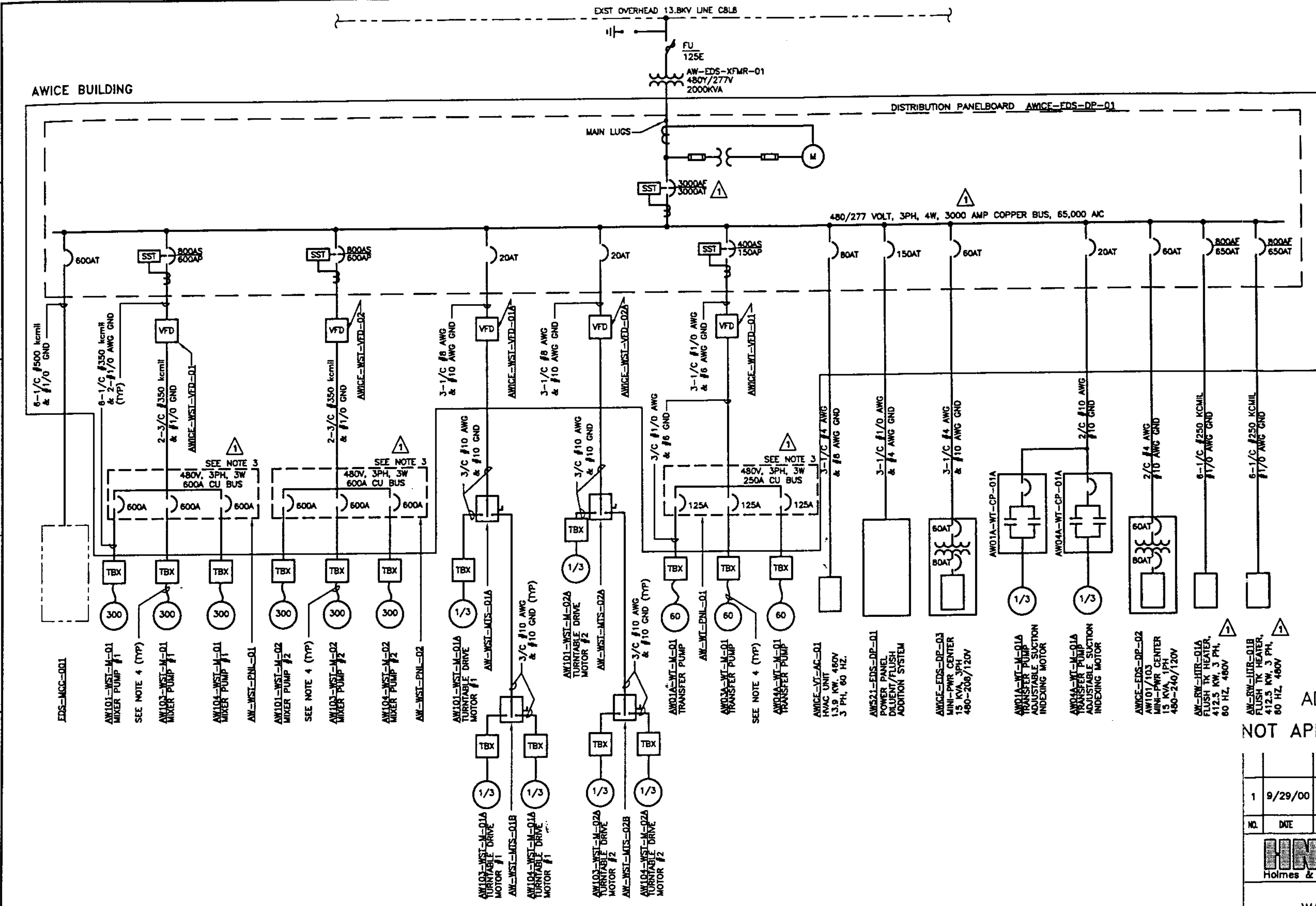
DRAWING NO. ESW-521-E1

REV. 1

RPP-7069, Rev. 0

NOTES:

1. SEE ESW-521-E1 FOR SYMBOL LEGEND.
2. SEE OUTLINE SPECIFICATION SECTION: 16400
3. PANELBOARD WITH 3 BREAKERS CONTROLLED BY KIRK KEY INTERLOCK SO THAT ONLY ONE BREAKER CAN BE ENERGIZED.
4. CABLES FROM MIXER PUMP AND TRANSFER PUMPS TO TBX ARE SUPPLIED WITH THE PUMP.



ONE LINE DIAGRAM

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5 & 4.9	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-AW TANK FARM

BLDG. 241-AW, 241-AW-271

FOR
CH2M HILL HANFORD GROUP, INC.

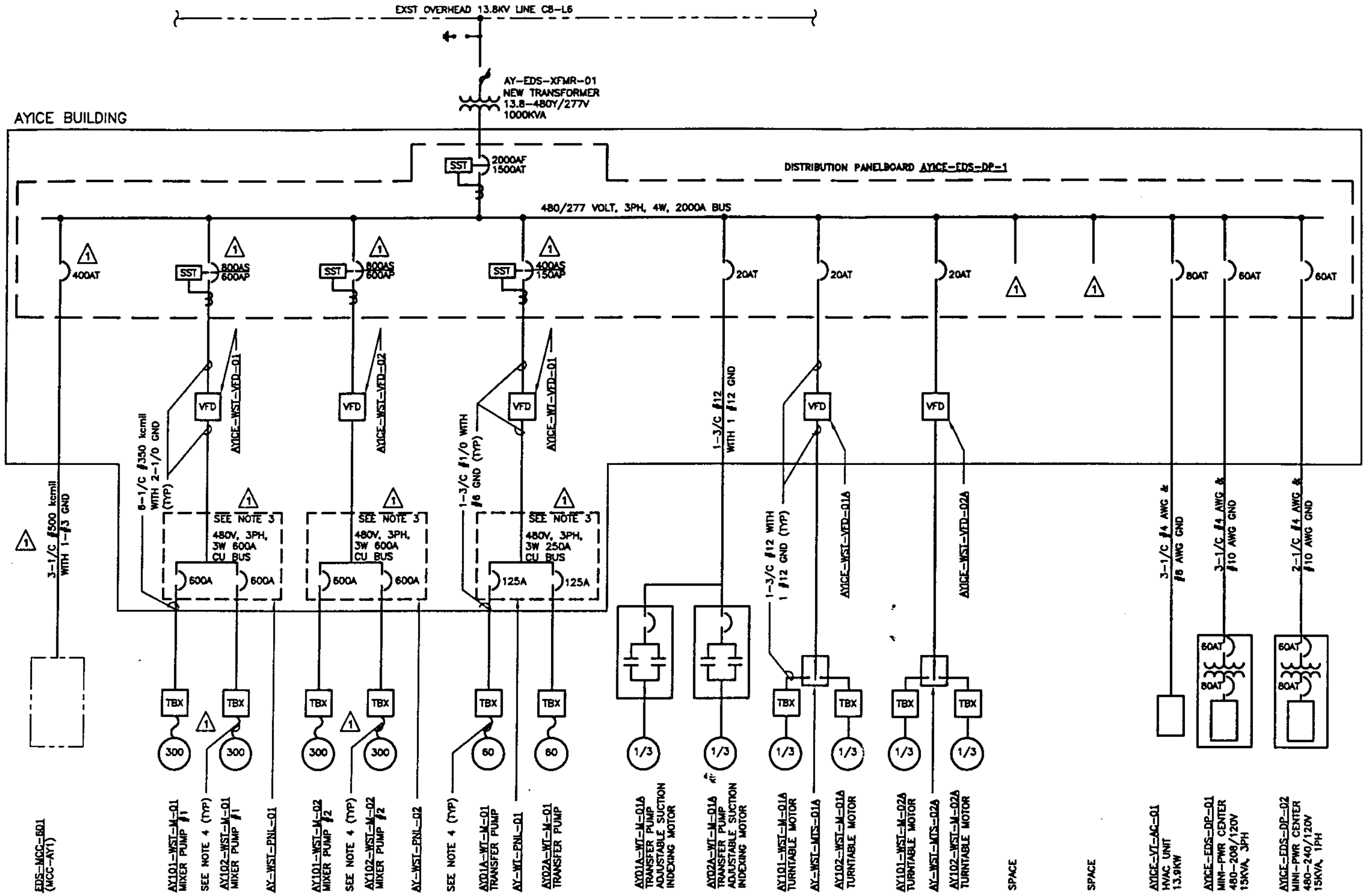
DRAWN	KARI S. HALE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-E3 — REV. 1

NOTES:

1. SEE ESW-521-E1 FOR SYMBOL LEGEND.
2. SEE OUTLINE SPECIFICATION SECTIONS: 16400
3. PANELBOARD WITH 2 BREAKERS CONTROLLED BY KIRK KEY INTERLOCK SO THAT ONLY ONE BREAKER CAN BE ENERGIZED.
4. CABLES FROM MIXER PUMP AND TRANSFER PUMPS TO TERMINAL BOX (TBX) ARE SUPPLIED WITH THE PUMP.



ONE LINE DIAGRAM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.7 & 4.9	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — EVERGREEN SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-AY TANK FARM

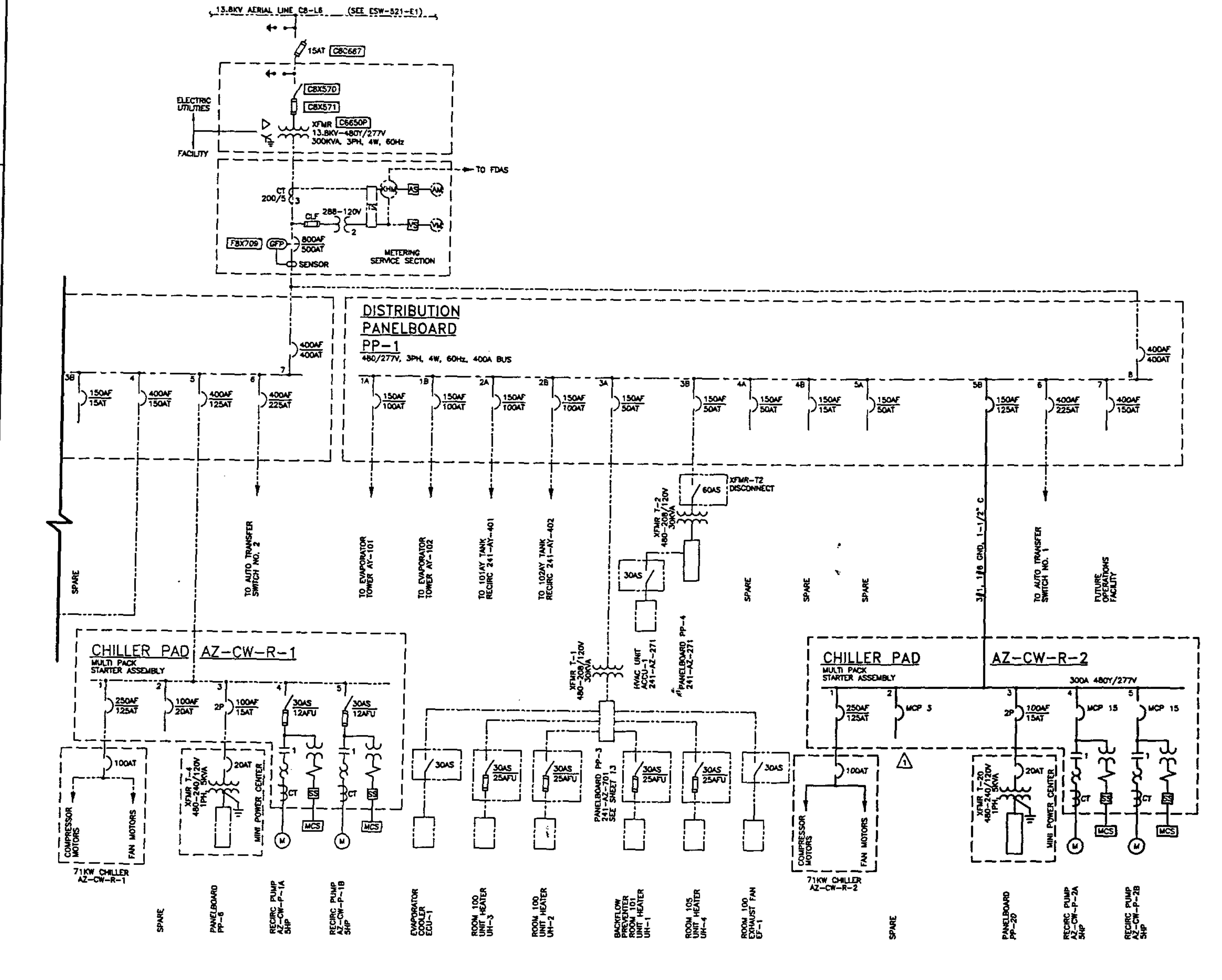
DRAWN	KARI S. HALE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

BLDG. 241-AY-101

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-E4 — REV. 1



PARTIAL ONE LINE DIAGRAM
(REF H-14-030007, SH 3)

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY
ELECTRICAL
ONE LINE DIAGRAM
241-AZ-702

BLDG. 241-AZ-702
FOR
CH2M HILL HANFORD GROUP, INC.

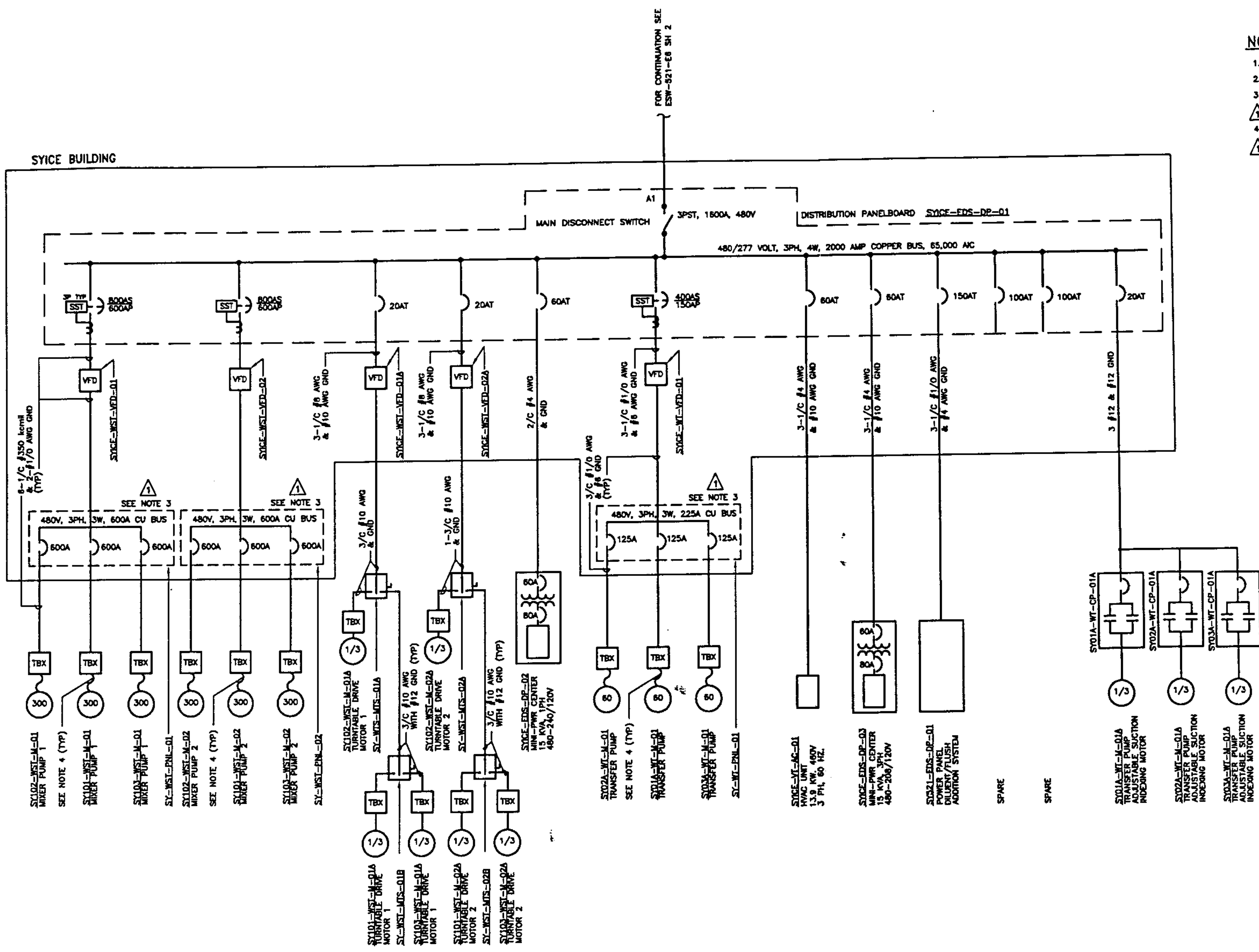
DRAWN	KARI S. HALE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-E5	1

NOTES:

1. SEE ESW-521-E1 FOR SYMBOL LEGEND.
2. SEE OUTLINE SPECIFICATION SECTIONS: 16400
3. PANELBOARD WITH 3 BREAKERS CONTROLLED BY KIRK KEY INTERLOCK SO THAT ONLY ONE BREAKER CAN BE ENERGIZED.
4. CABLES FROM MIXER PUMP AND TRANSFER PUMPS TO TERMINAL BOX (TBX) ARE SUPPLIED WITH THE PUMP.



ONE LINE DIAGRAM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.9	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-SY TANK FARM

BLDG. 241-SY-101,-102,-103; 241-SY-ICE

DRAWN: KARI S. HALE
DESIGN: R. GOLBERG
CHECKED:
RELEASED:
DATE:

FOR CH2M HILL HANFORD GROUP, INC.

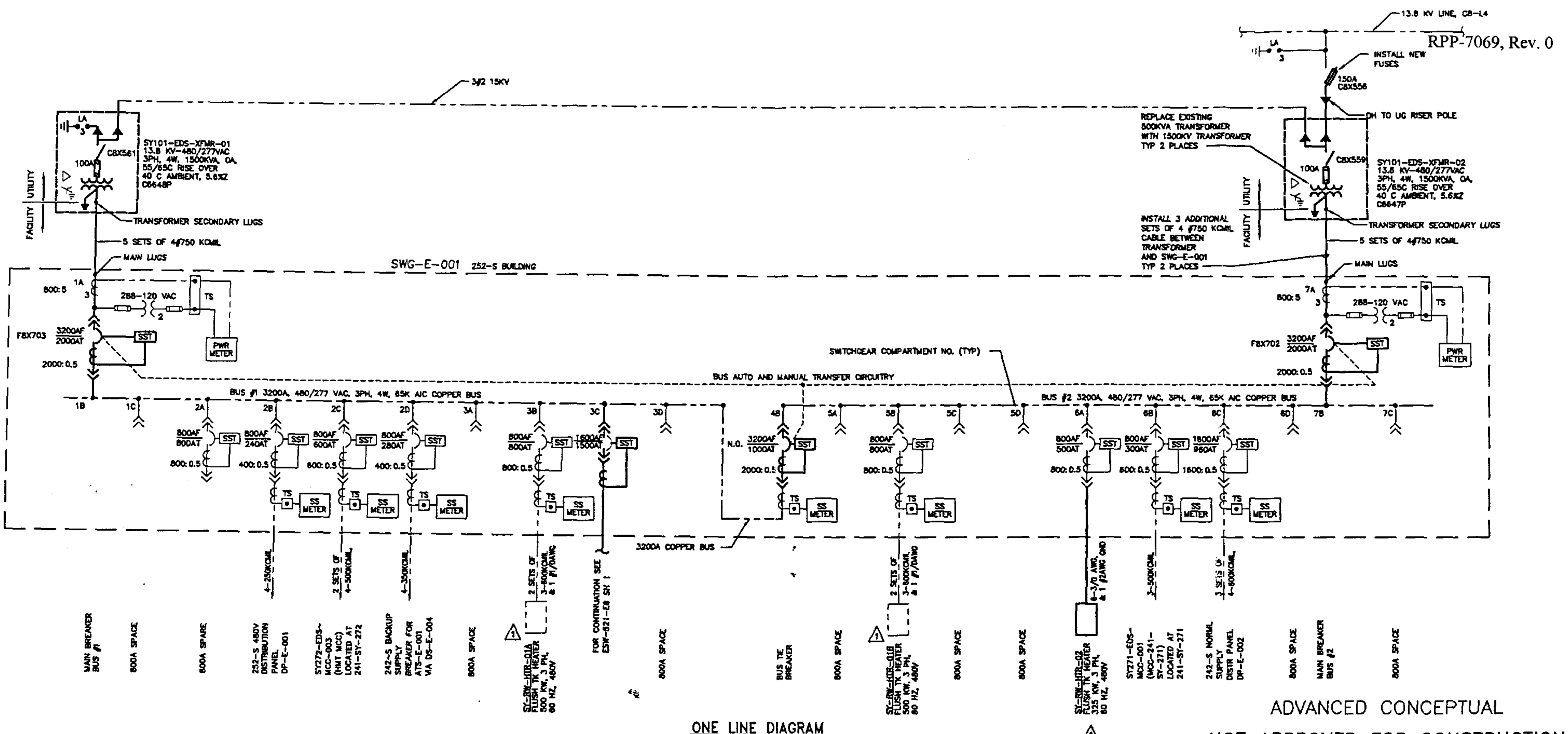
SHEET 1 OF 2

PROJECT ID 9909202.03

DRAWING NO. ESW-521-E6

REV. 1

RPP-7069, Rev. 0



ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NOTES:

1. SEE ESW-521-E1 FOR SYMBOL LEGEND.
2. SEE OUTLINE SPECIFICATION SECTIONS: 16400
3. REPLACE EXISTING SENSOR IN COMPARTMENTS 1B, 4B AND 7B WITH A 2000 AMP SENSOR.

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.5	KSH	KSH					

HND Holmes & Narver/DMJM — ARES CORPORATION — Babcock Services M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-SY TANK FARM

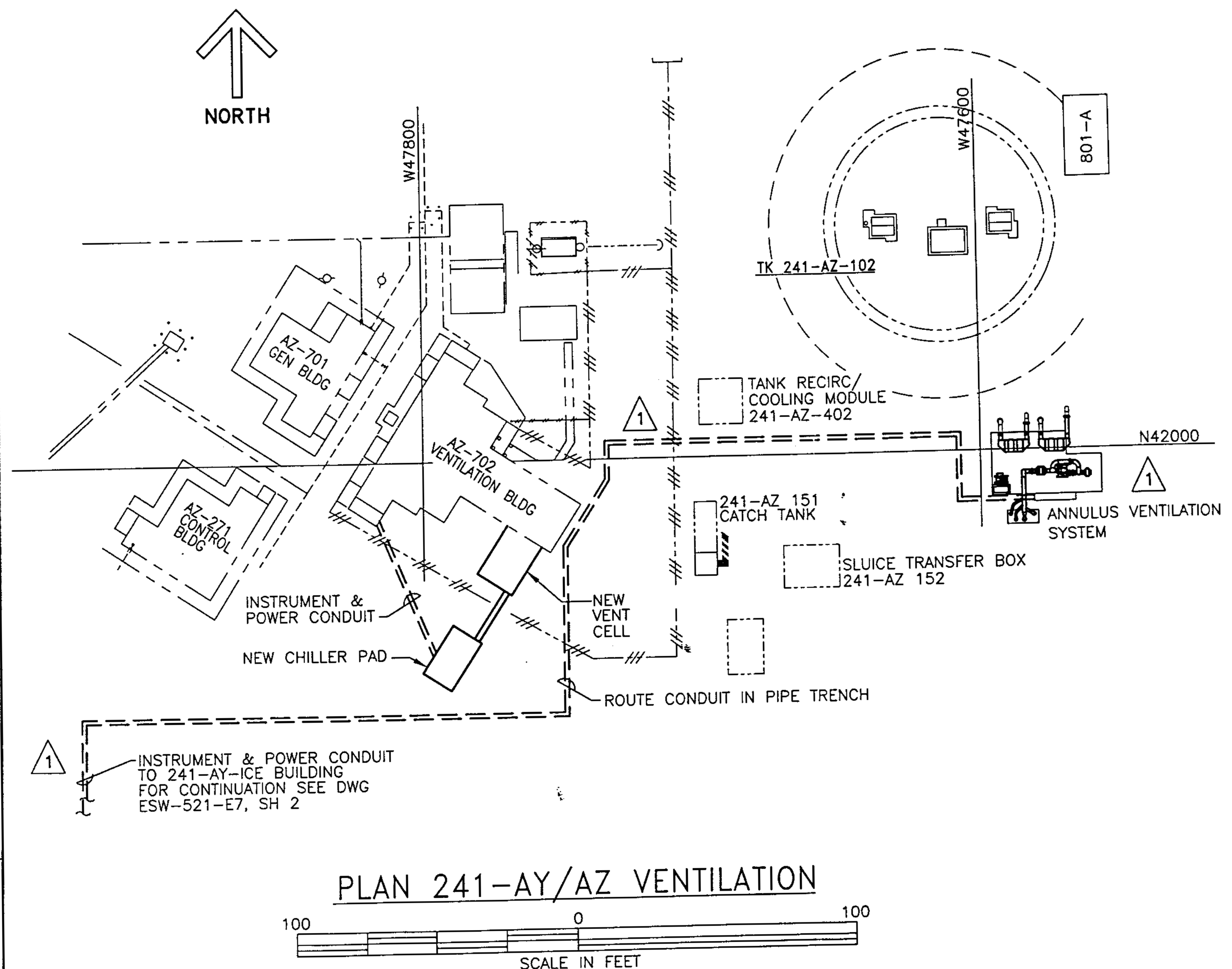
BLDG. 241-SY-101,-102,-103; 241-SY ICE

DRAWN	KARI S. HALE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 2 OF 2

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-E6	1



PLAN 241-AY/AZ VENTILATION

LEGEND

- —//—//— PERIMETER FENCE
- —·—·— EXISTING
- — — — UNDERGROUND CONDUIT (W-521)
- - - - - EXISTING UNDERGROUND LINES

NOTES:

1. SEE OUTLINE SPECIFICATION SECTION: 16400
2. SEE ESW-521-E11 FOR TYPICAL ELECTRICAL DETAILS.

ADVANCED CONCEPTUAL
NOT APPROVED FOR CONSTRUCTION

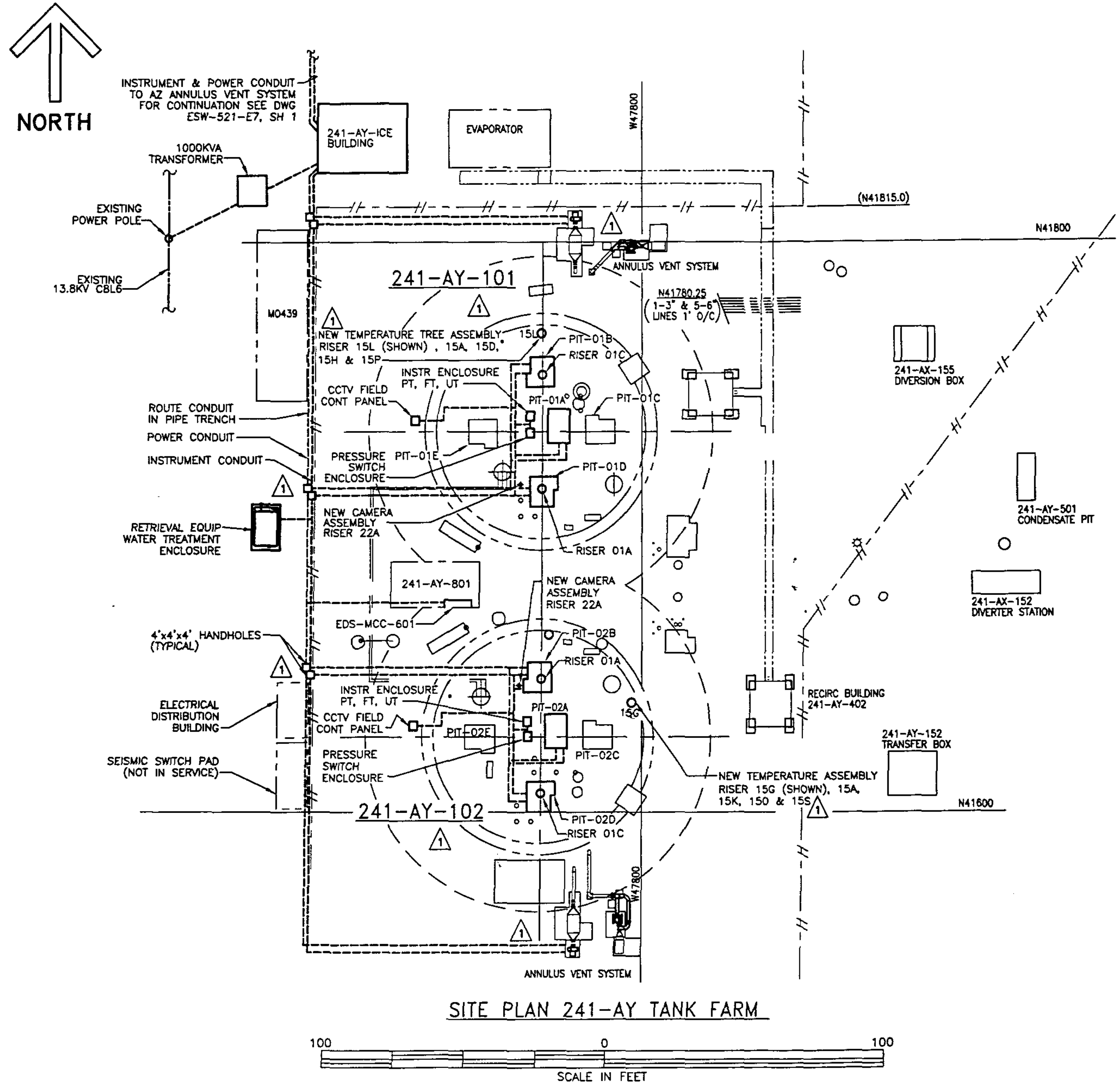
NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.3	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
ELECTRICAL
241-AY/AZ VENTILATION PLAN

DRAWN	J. DEVINE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

BLDG. 241-AZ
FOR CH2M HILL HANFORD GROUP, INC.
SHEET 1 OF 2
PROJECT ID 9909202.03
DRAWING NO. ESW-521-E7
REV. 1



LEGEND

- — -//- — FENCE
- ——E—— ELECTRICAL (OVERHEAD)
- —·—·—·— EXISTING
- - - - - - UNDERGROUND CONDUIT (W-521)

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS: 16400
2. SEE ESW-521-E11 FOR TYPICAL ELECTRICAL DETAILS.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.3, 4.7, 4.9, 4.10, & 4.16	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
ELECTRICAL
PLAN 241-AY TANK FARM

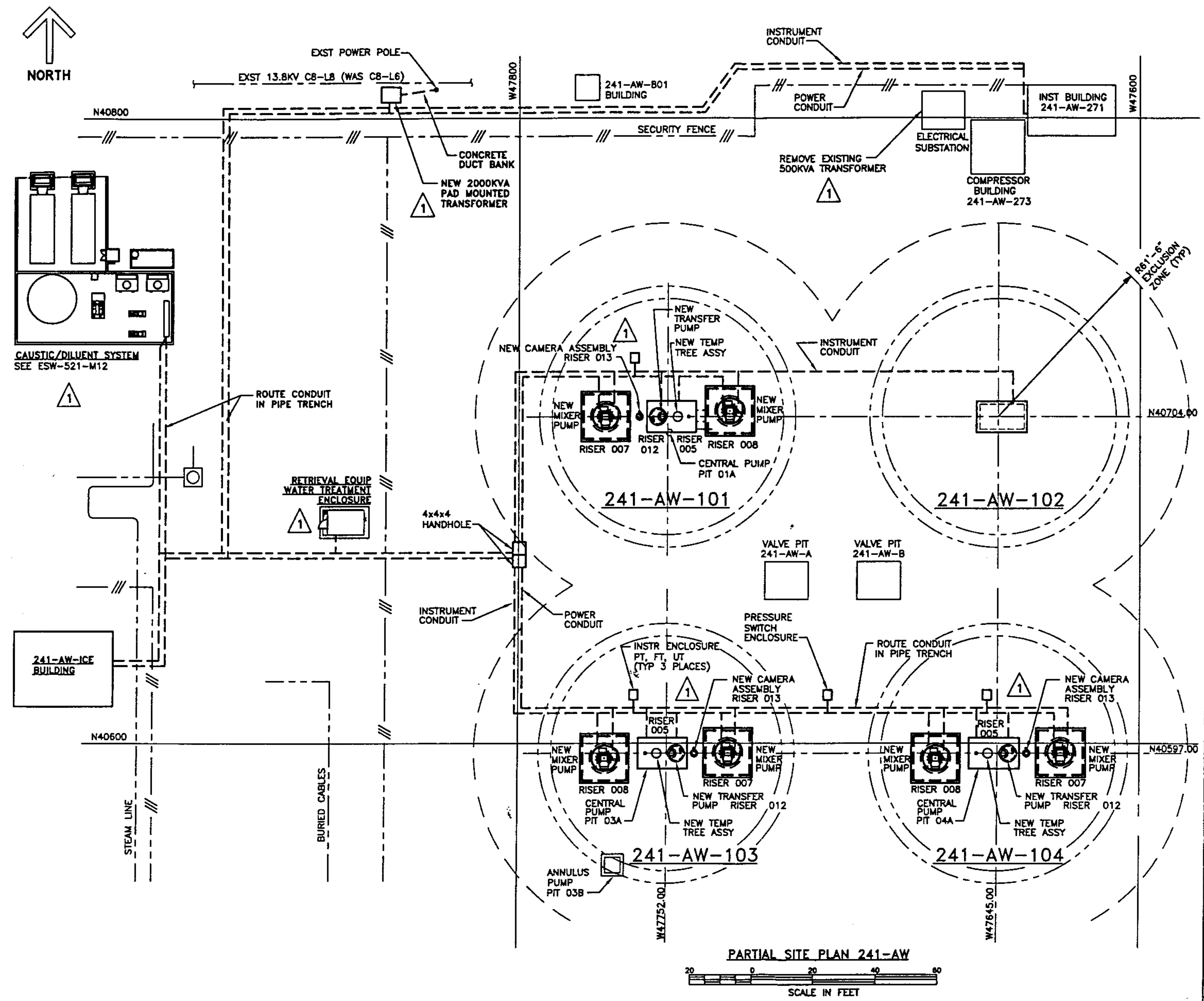
DRAWN	J. DEVINE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

BLDG. 241-AY

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 2 OF 2

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-E7 — REV. 1



LEGEND

——///——	PERIMETER FENCE
— — — —	NEW UNDERGROUND CONDUIT (W-521)
——— - - —	EXISTING

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS: 16400
2. SEE ESW-521-E11 FOR TYPICAL ELECTRICAL DETAILS.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.6, 4.9, 4.10 & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
PLAN 241-AW TANK FARM

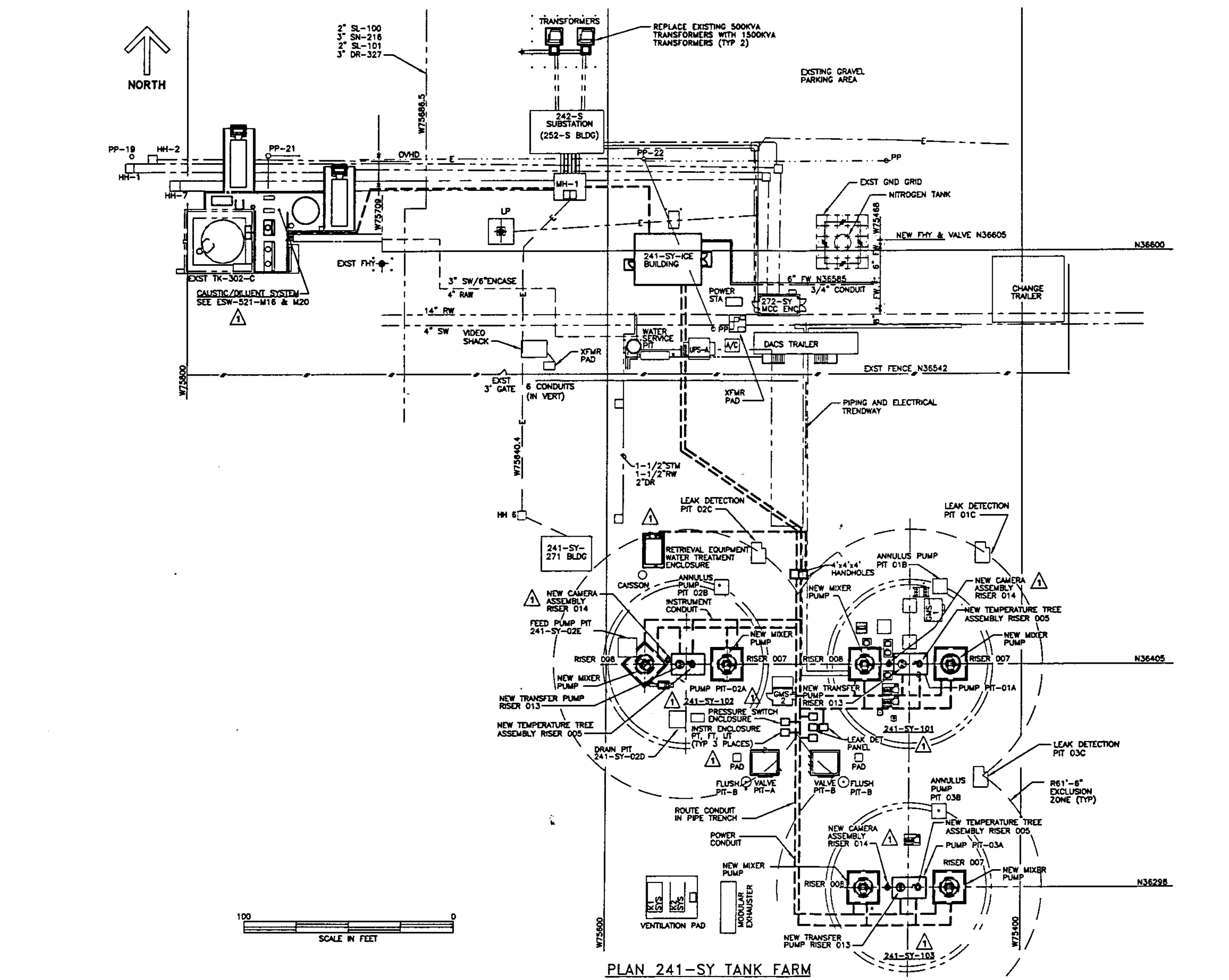
BLDG. 241-AW

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN	J. DEVINE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

SHEET 1 OF 1

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-E8 — REV. 1



LEGEND

- PERIMETER FENCE
- EXISTING UTILITY LINES
- EXISTING
- NEW (W-521)
- UNDERGROUND CONDUIT (W-521)

NOTES:

1. SEE OUTLINE SPECIFICATION SECTION: 16400
2. SEE ESW-521-E11 FOR TYPICAL ELECTRICAL DETAILS.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.6, 4.9, 4.10 & 4.16	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY
ELECTRICAL
PLAN 241-SY TANK FARM

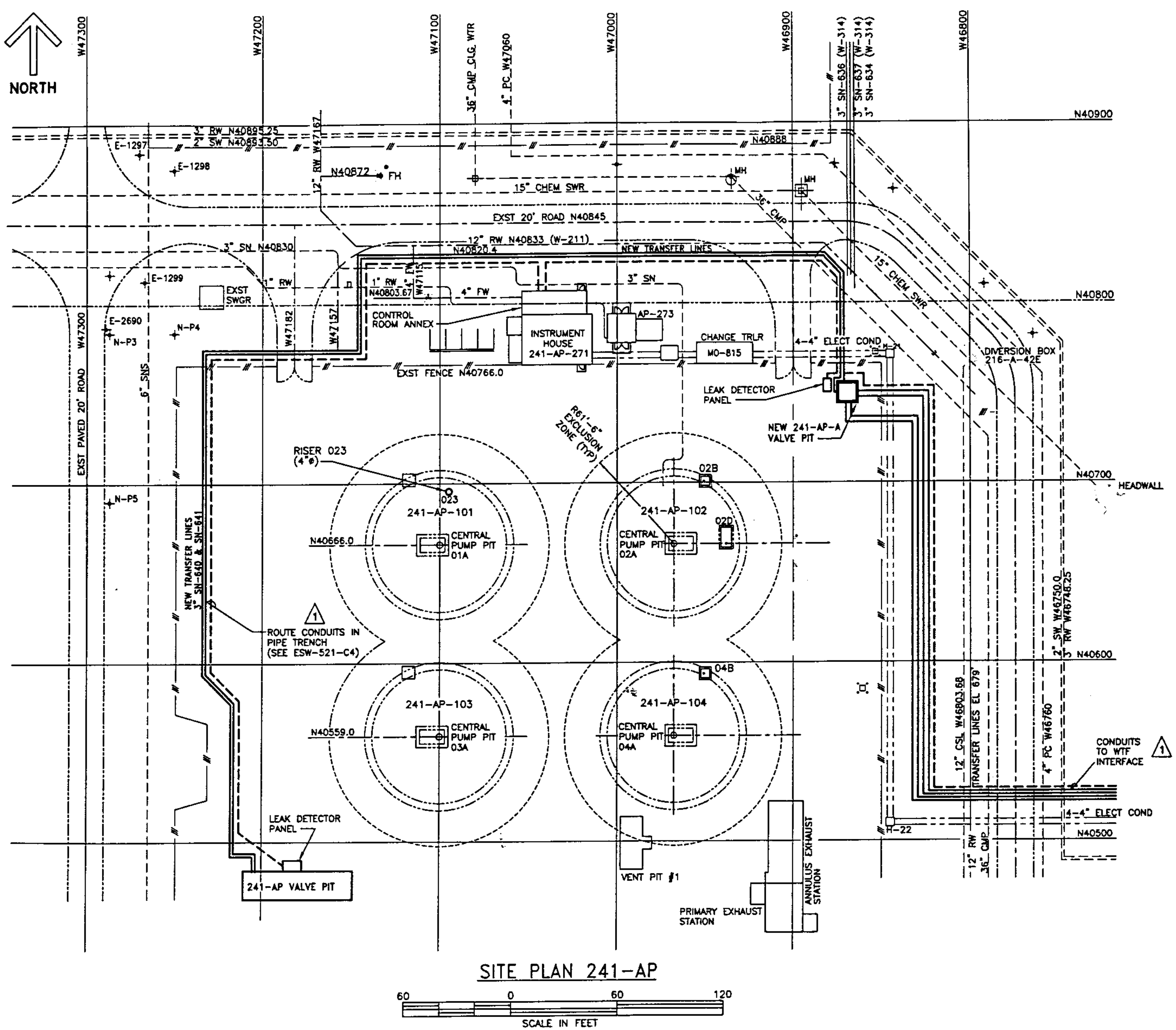
DRAWN	J. DEVINE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

BLDG. 241-SY

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID	DRAWING NO.	REV.
9909202.03	ESW-521-E9	1



SITE PLAN 241-AP

60 0 60 120
SCALE IN FEET

LEGEND

- PERIMETER FENCE
- E — ELECTRICAL (OVERHEAD)
- UNDERGROUND CONDUIT (W-521)
- EXISTING UNDERGROUND LINES
- PP — POWER POLE

NOTES:

1. SEE OUTLINE SPECIFICATION SECTIONS: 16400
2. SEE ESW-521-E11 FOR TYPICAL ELECTRICAL DETAILS.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, RO, PARAGRAPH 4.8; CHANGED BNFL TO WTF	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
PLAN 241-AP TANK FARM

BLDG. 241-AP

FOR CH2M HILL HANFORD GROUP, INC.

DRAWN	J DEVINE
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

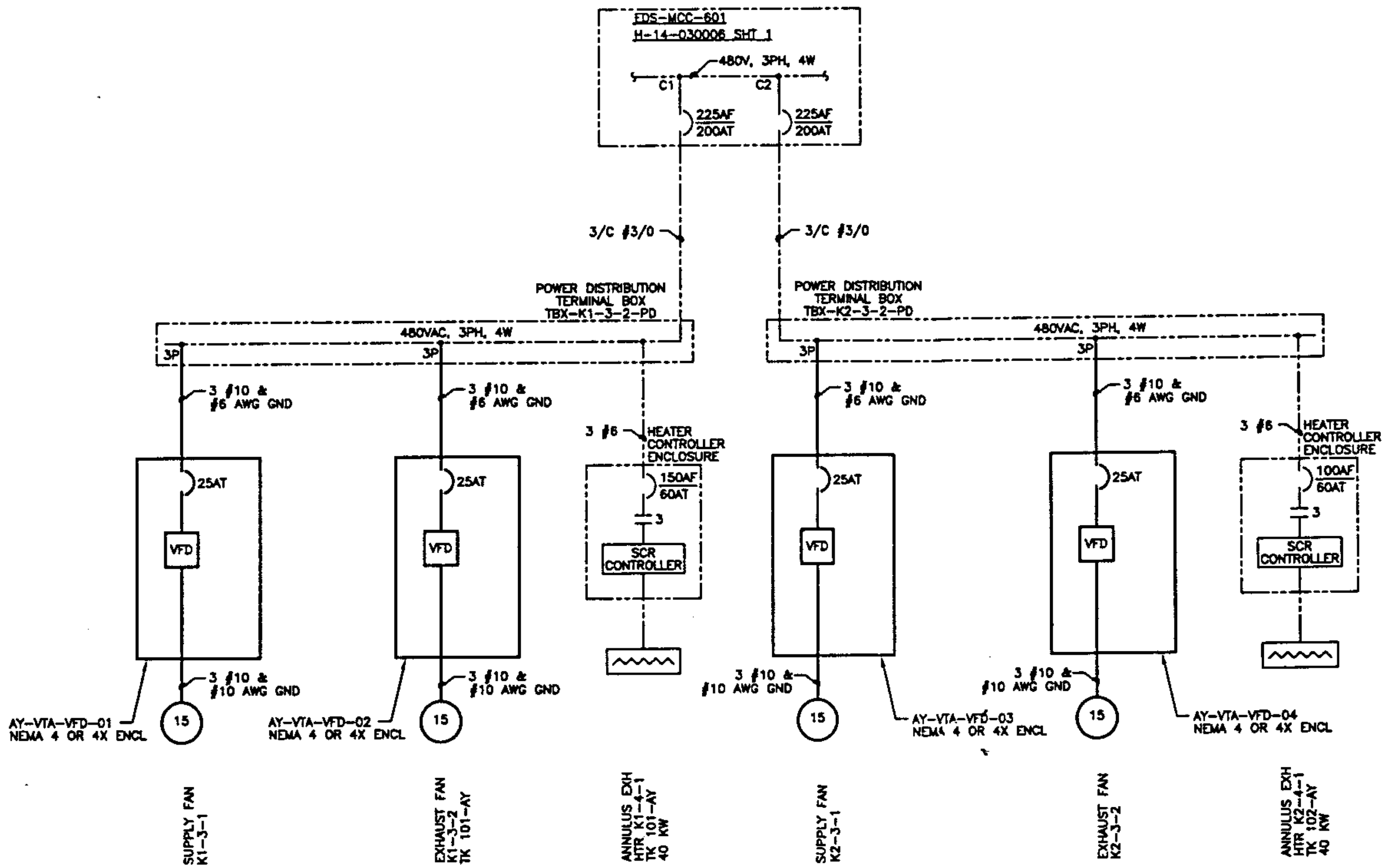
SHEET 1 OF 1

PROJECT ID 9909202.03 — DRAWING NO. ESW-521-E10 — REV. 1

LEGEND

- - - - EXISTING

—— NEW



AY ANNULUS VENTILATION ONE LINE DIAGRAM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-AY ANNULUS

DRAWN	R.E. WILSON
DESIGN	R. GOLBERG
CHECKED	
RELEASED	
DATE	

BLDG. 241-AY

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 1 OF 1

PROJECT ID 9909202.03

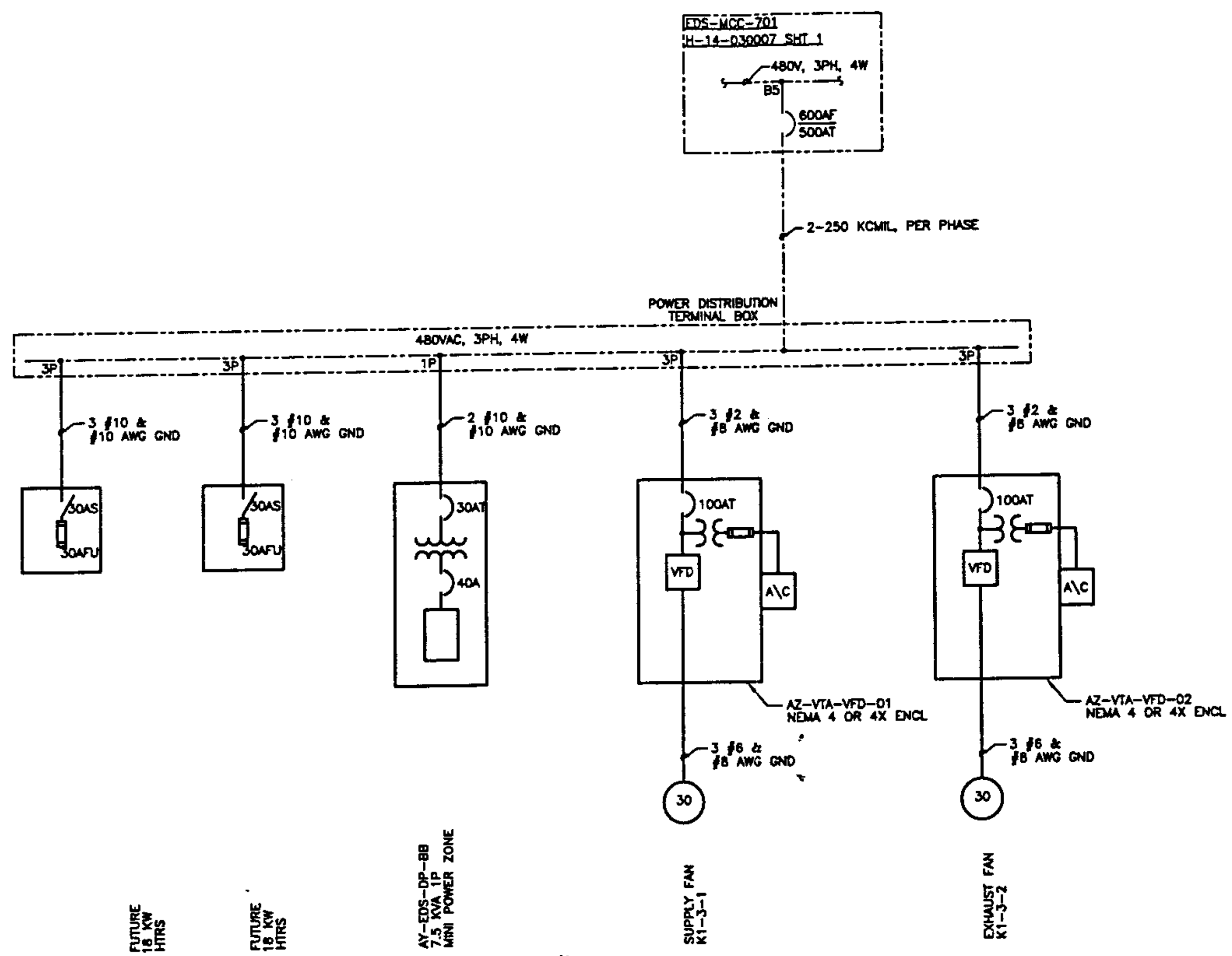
DRAWING NO. ESW-521-E12

REV. 0

LEGEND

EXISTING

NEW



AZ ANNULUS VENTILATION ONE LINE DIAGRAM

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
0	9/29/00		ADDED NEW DRAWING PER RPP-7069, R0, PARAGRAPH 4.3	RM	RM					

Holmes & Narver/DMJM — ARES CORPORATION — BABCOCK SERVICES M&D

PROJECT W-521
WASTE FEED DELIVERY

ELECTRICAL
ONE LINE DIAGRAM
241-AZ ANNULUS

BLDG. 241-AZ

FOR CH2M HILL HANFORD GROUP, INC.

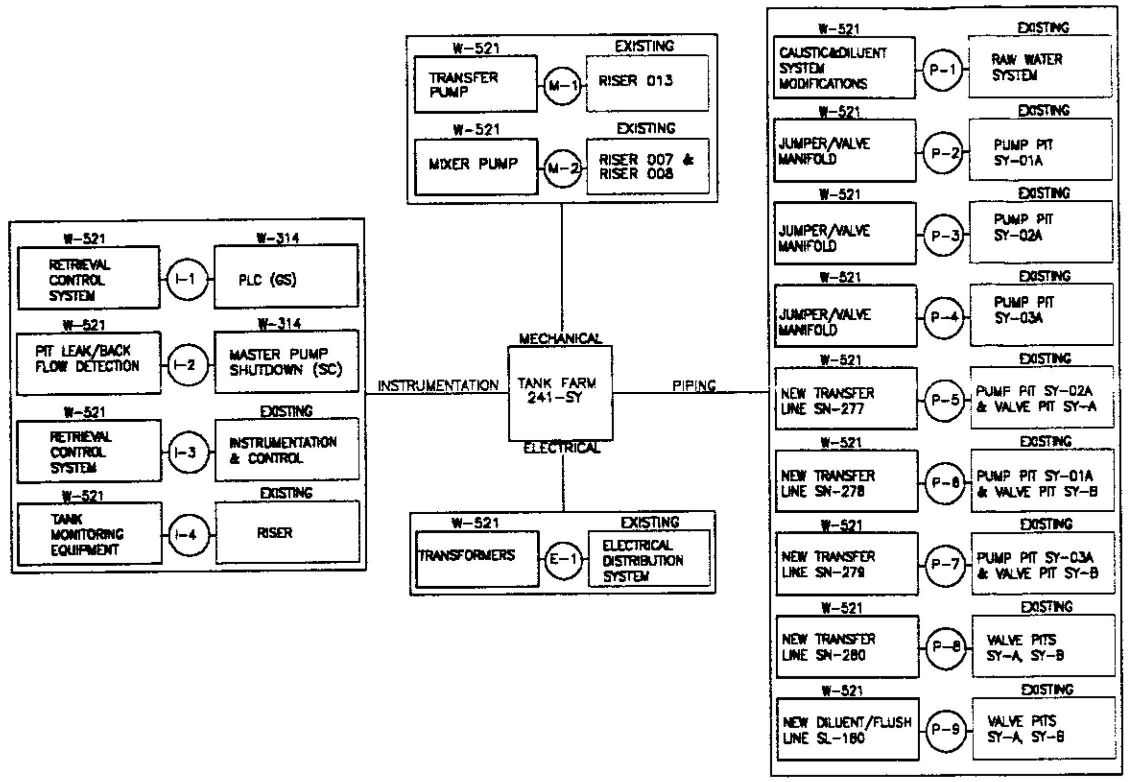
DRAWN R.E. WILSON
DESIGN R. GOLBERG
CHECKED
RELEASED
DATE

SHEET 1 OF 1

PROJECT ID 9909202.03

DRAWING NO. ESW-521-E13

REV. 0



241 SY TANK FARM INTERFACE CONTROL DIAGRAM

INTERFACE #	REFERENCE DWGS	REQUIREMENTS
I/F-SY-E-1	ESW-521-E6 & ESW-521-E9	W-521 SHALL REPLACE THE (2) EXISTING TRANSFORMERS FEEDING THE SY TANK FARM ELECTRICAL DISTRIBUTION SYSTEM. W-521 SHALL PROVIDE AN ADDITIONAL 325KW DILUENT/FLUSH CIRCULATION HEATER. ⚠1
I/F-SY-I-1	ESW-521-I&C1, SH 1	DATA LINK MUST BE COMPATIBLE WITH W-314. SUBSEQUENT PROGRAMMING SHALL BE PERFORMED BY W-521.
I/F-SY-I-2	ESW-521-I&C1, SH 1	SUFFICIENT RACK SPACE PROVIDED BY W-314 TO SUPPORT ADDITIONAL I/O. SUBSEQUENT PROGRAMMING SHALL BE PERFORMED BY W-521.
I/F-SY-I-3	ESW-521-I&C1	W-521 RETRIEVAL CONTROL SYSTEM SHALL BE COMPATIBLE WITH EXISTING INSTRUMENTATION. W-521 SHALL REPLACE EXISTING DILUENT/FLUSH CIRCULATION HEATER CONTROLS SYSTEM. ⚠1
I/F-SY-I-4	ESW-521-P6, SH 3	W-521 INSTRUMENTATION AND CCTV CONFIGURATION SHALL BE COMPATIBLE WITH RISER.
I/F-SY-M-1	ESW-521-M7 & ESW-521-M1, SH 3	W-521 TRANSFER PUMP SHALL BE SIZED TO BE COMPATIBLE WITH EXISTING COVER.
I/F-SY-M-2	ESW-521-M6 & ESW-521-M1, SH 2	W-521 MIXER PUMP FLANGE WILL BE CONFIGURED TO MEET WITH EXISTING RISER.
I/F-SY-P-1	ESW-521-M6 & ESW-521-M16	W-521 CAUSTIC AND DILUENT ADDITION SHALL BE COMPATIBLE WITH EXISTING RAW WATER SYSTEM.
I/F-SY-P-2	ESW-521-M7	W-521 JUMPER SHALL BE COMPATIBLE WITH EXISTING PUMP PIT.
I/F-SY-P-3	ESW-521-M7	W-521 JUMPER SHALL BE COMPATIBLE WITH EXISTING PUMP PIT.
I/F-SY-P-4	ESW-521-M7	W-521 JUMPER SHALL BE COMPATIBLE WITH EXISTING PUMP PIT.
I/F-SY-P-5	ESW-521-M6 & ESW-521-M11	W-521 3" LINE & NOZZLE SHALL BE COMPATIBLE WITH EXISTING LINE TO PROVIDE 140 GPM.
I/F-SY-P-6	ESW-521-M6 & ESW-521-M11	W-521 3" LINE & NOZZLE SHALL BE COMPATIBLE WITH EXISTING LINE TO PROVIDE 140 GPM.
I/F-SY-P-7	ESW-521-M6 & ESW-521-M11	W-521 3" LINE & NOZZLE SHALL BE COMPATIBLE WITH EXISTING LINE TO PROVIDE 140 GPM.
I/F-SY-P-8	ESW-521-M6 & ESW-521-M11	W-521 3" LINE & NOZZLE SHALL BE COMPATIBLE WITH EXISTING LINE TO PROVIDE 140 GPM.
I/F-SY-P-9	ESW-521-M6 & ESW-521-M11	W-521 2" LINE & NOZZLE SHALL BE COMPATIBLE WITH EXISTING VALVE PIT LINE.

ADVANCED CONCEPTUAL

NOT APPROVED FOR CONSTRUCTION

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REL	SUB	REC	APP
1	9/29/00		REVISED PER RPP-7069, R0, PARAGRAPH 4.5	RM	RM					

HND Holmes & Narver/DMJM — ARES CORPORATION — M&D

PROJECT W-521
WASTE FEED DELIVERY
INTERFACE CONTROL
241-SY

DRAWN	R.WILSON
DESIGN	N.ROE
CHECKED	
RELEASED	
DATE	

BLDG. 241-SY

FOR CH2M HILL HANFORD GROUP, INC.

SHEET 3 OF 3

PROJECT ID 9909202.03

DRAWING NO. ESW-521-ICD1

REV. 1

Attachment S

Attachment S

Revised Master Equipment List

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
0	AWICE-EDS-DP-1	AWICE BUILDING DISTRIBUTION PANEL	241-AW	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-3		NO SAFETY FUNCTION	PC1						3		Y
0	AWICE-EDS-DP-01	MINI-POWER CENTER	241-AW	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-3		NO SAFETY FUNCTION	PC1						3		Y
0	AWICE-EDS-DP-02	MINI-POWER CENTER AW101/AW103	241-AW	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-3		NO SAFETY FUNCTION	PC1						3		N
0	AWICE-VT-AC-01	HVAC	241-AW	GS (HNF-SD-WM-SEL-040 REV 4)			ESW-521-E-3 H755		NO SAFETY FUNCTION	PC1						3		N
0	C5662P (NEW)	1000 KVA TRANSFORMER	241-AW	GS (HNF-SD-WM-SEL-040 REV 4)			ESW-521-E-3		NO SAFETY FUNCTION	PC 1						3		N
6	AW101-WST-P-01	AW101 MIXER PUMP #1	241-AW	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610				2 x 10^7 R (TID)	3		N
6	AW101-WST-M-01	AW101 MIXER PUMP #1 MOTOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3, sh1		NO SAFETY FUNCTION	PC1		480V		NEMA-MG-1		3		N
6	AWICE-WST-VFD-01	AW101 MIXER PUMP #1 VARIABLE FREQUENCY DRIVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3		NO SAFETY FUNCTION	PC1		480V				3		N
6	AWICE-WST-PNL-01	POWER PANEL MIXER PUMP #1	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
6	AW101-WST-M-01A	AW101 MIXER PUMP #1 TURNTABLE MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
6	AWICE-WST-VFD-01A	AW101 TURNTABLE MOTOR #1 VARIABLE FREQUENCY DRIVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3		NO SAFETY FUNCTION	PC1						3		N
6	AW101-WST-MTS-01A	AW101 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #1)	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	AW01A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC-1						3		N
6	AW101-WST-P-02	AW101 MIXER PUMP #2	241-AW	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1					2 x 10^7 R (TID	3		N
6	AW101-WST-M-02	AW101 MIXER PUMP #2 MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-3, sh1		NO SAFETY FUNCTION	PC1		480V		NEMA-MG-1		3		N
6	AWICE-WST-VFD-02	AW101 MIXER PUMP #2 VARIABLE FREQUENCY DRIVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3		NO SAFETY FUNCTION	PC1		480V				3		N
6	AWICE-WST-PNL-02	POWER PANEL MIXER PUMP #2	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
6	AW101-WST-M-02A	AW101 MIXER PUMP #2 TURNTABLE MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
6	AWICE-WST-VFD-02A	AW101 TURNTABLE MOTOR #2 VARIABLE FREQUENCY DRIVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3		NO SAFETY FUNCTION	PC1						3		N
6	AW101-WST-MTS-02A	AW101 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #2)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	AW521-EDS-DP-01	DISTRIBUTION PANEL CAUSTIC DILUENT ADDITION SYSTEM	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-P-01	AW101 TRANSFER PUMP	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	373.1M, ASME VIII (HNF-PRO-704)					3		N
8	AW01A-WT-M-01	AW101 TRANSFER PUMP MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AW01A-WT-M-01A	AW101 TRANSFER PUMP ADJUSTABLE SUCTION INDEXING MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AWICE-WT-PNL-01	POWER PANEL TRANSFER PUMP	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
8	AWICE-WT-VFD-01	AW101 TRANSFER PUMP VARIABLE FREQUENCY DRIVE	241-AW	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-3		NO SAFETY FUNCTION	PC1						3		N
8	AW01-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFG/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AW01A-WT-MOV-101	AW101 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	AW01A-WT-MOV-102	AW101 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	AW01A-WT-MOV-103	AW101 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	AW01A-WT-MOV-104	AW101 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	AW01A-WT-FV-212	AW101 WASTE FLOW CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AW01A-WT-V-106	AW101 DILUENT/FLUSH CHECK VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	3		Y
8	AW101-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		FUNCTIONIN-TANK EQUIPMENT, LOSS OF CCTV PURGE -	PC1						1		N
8	AW101-WST-ZS-202	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #1)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AWICE-UT-AC-01	HVAC UNIT	241-AW	GS (LTR CHG-0000281)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-ZS-203	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #1)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-VT-204	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-ZS-209C	MIXER PUMP #1 TURNTABLE CCW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-VT-208	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PY-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PY-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-ZS-212	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #2)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-ZS-213	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #2)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AW101-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW-101-WST-VT-218	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-ZS-219C	MIXER PUMP #2 TURNTABLE CCW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-ZT-220	MIXER PUMP #2 TURNTABLE ANGLE POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PE-221	MIXER PUMP #2 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PY-221	MIXER PUMP #2 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PT-221	MIXER PUMP #2 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PE-222	MIXER PUMP #2 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PY-222	MIXER PUMP #2 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW101-WST-PT-222	MIXER PUMP #2 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE, UNDER DEVELOPMENT	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 1)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS IN-TANK EQUIPMENT	PC1					2 x 10^7 (TID)	1		N
0	AW101-EDS-XS-201	NORMAL POWER FAIL TRANSFER SW	241-AW	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA					3		N
6	AW101-WST-TV-01	AW101 CAMERA ASSEMBLY SYSTEM	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA				2 X 10^7 R (TID)	1		N
8	AW01A-WT-ZS-101	AW01A-WT-MOV-101 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS IN-TANK EQUIPMENT	PC1						3		N
8	AW01A-WT-ZS-102	AW01A-WT-MOV-102 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-ZT-212	AW01A-WT-FV-212 POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-ZS-212	AW01A-WT-FV-212 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-ZS-104	AW01A-WT-MOV-104 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-TE-208	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-ZS-209	TRANSFER PUMP TRANSFER SWITCH POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE EQUIPMENT-RELAY	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N

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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AW01A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-HS-210	TRANSFER PUMP PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-UE-212	FLOW, DENSITY, AND TEMP ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-UT-212	FLOW, DENSITY, AND TEMP TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-UY-212	FLOW, DENSITY, AND TEMP MULTIVARIABLE EQUIPMENT RELAY	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
6	AW101-WST-TE-301	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 10^7 (TID)	1		N
6	AW101-WST-TE-302	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 10^7 (TID)	1		N
6	AW101-WST-TE-303	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 (TID)	1		N
6	AW101-WST-TE-304	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 10^7 (TID)	1		N
6	AW101-WST-TE-305	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 (TID)	1		N
6	AW101-WST-TE-306	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 10^7 (TID)	1		N
6	AW101-WST-TE-307	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 107 (TID)	1		N
6	AW101-WST-TE-308	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 107 (TID)	1		N
6	AW101-WST-TE-309	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 107 (TID)	1		N
6	AW101-WST-TE-310	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 10^7 (TID)	1		N
6	AW101-WST-TE-311	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 (TID)	1		N
6	AW101-WST-TE-312	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 R (TID)	1		N
6	AW101-WST-TE-313	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 R (TID)	1		N
6	AW101-WST-TE-314	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 R (TID)	1		N
6	AW101-WST-TE-315	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 R (TID)	1		N
6	AW101-WST-TE-316	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 R (TID)	1		N
6	AW101-WST-TE-317	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2x 10^7 R (TID)	1		N
6	AW101-WST-TE-318	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2				300°F	2 x 10^7 R(TID)	1		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AW01A-WT-ZT-205	TRANSFER PUMP SUCTION INLET POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-ZS-206	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW01A-WT-ZS-207	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
[redacted]																		
6	AW103-WST-P-01	AW103 MIXER PUMP #1	241-AW	GS			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	API 610					3		N
6	AW103-WST-M-01	AW103 MIXER PUMP #1 MOTOR	241-AW	GS			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1		480V		NEMA-MG-1		3		N
6	AW103-WST-M-01A	AW103 MIXER PUMP #1 TURNTABLE MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
6	AW103-WST-MTS-01A	AW103 MANUAL TRANSFER SWITCH TURNABLE DRIVE MIXER PUMP #1	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	AW03A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	AW103-WST-P-02	AW103 MIXER PUMP #2	241-AW	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	API 610			300°F	2 x 10^7 R(TID)	3		N
6	AW103-WST-M-02	AW103 MIXER PUMP #2 MOTOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	AW103-WST-M-02A	AW103 MIXER PUMP #2 TURNTABLE MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AW103-WST-MTS-02A	AW103 MANUAL TRANSFER SWITCH TURNABLE DRIVE MIXER PUMP #2	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
8	AW03A-WT-P-01	AW103 TRANSFER PUMP	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	API 610					3		N
8	AW03A-WT-M-01	AW103 TRANSFER PUMP MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AW03-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-MOV-101	AW103 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AW03A-WT-MOV-102	AW103 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AW03A-WT-MOV-103	AW103 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AW03A-WT-MOV-104	AW103 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AW03A-WT-FV-212	AW103 WASTE FLOW VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AW03A-WT-V-106	AW103 DILUENT/FLUSH CHECK VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS				3		Y
8	AW103-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		LOSS OF CCTV PURGE - IGNITION SOURCE	PC1						1		Y
8	AW103-WST-ZS-202	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP#1)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-ZS-203	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #1)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-VT-204	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AW103-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-ZS-209C	MIXER PUMP #1 TURNTABLE CCW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-VT-206	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-PY-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-PY-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		Y
8	AW103-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-ZS-212	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #2)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-ZS-213	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #2)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW-103-WST-VT-218	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-ZS-219C	MIXER PUMP #2 TURNTABLE CCW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW103-WST-ZT-220	MIXER PUMP TURNTABLE ANGLE POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW103-WST-PE-221	MIXER PUMP #2 DISCHARGE PRESSURE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW103-WST-PY-221	MIXER PUMP #2 DISCHARGE PRESSURE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW103-WST-PT-221	MIXER PUMP #2 DISCHARGE PRESSURE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AW103-WST-PE-222	MIXER PUMP #2 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW103-WST-PY-222	MIXER PUMP #2 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW103-WST-PT-222	MIXER PUMP #2 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE, UNDER DEVELOPMENT	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 1)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT	PC1						1		N
0	AW103-EDS-XS-201	NORMAL POWER FAIL TRANSFER SW	241-AW	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA					3		N
6	AW103-WST-TV-01	AW103 CAMERA ASSEMBLY SYSTEM	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS IN-TANK EQUIPMENT	PC1	NEC, NEMA				2 x 10^7 R(TID)	1		N
8	AW03A-WT-ZS-101	AW03A-WT-MOV-101 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-ZS-102	AW03A-WT-MOV-102 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-ZS-103	AW03A-WT-MOV-103 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-ZS-104	AW03A-WT-MOV-104 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-ZE-212	AW03A-WT-FV-212 POSITION ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-ZT-212	AW03A-WT-FV-212 POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-TE-208	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-ZS-209	TRANSFER PUMP TRANSFER SWITCH POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-HS-210	TRANSFER PUMP PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-UE-212	FLOW, DENSITY, AND TEMP ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-UT-212	FLOW, DENSITY, AND TEMP TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-UY-212	FLOW, DENSITY, AND TEMP MULTIVARIABLE EQUIPMENT TRANSDUCER	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW03A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
6	AW103-WST-TE-301	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW103-WST-TE-302	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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** = SEISMIC ANCHORING REQUIRED
1 UBC, ZONE 2B, STANDARD OCCUPANCY
2 UBC, ZONE 2B, ESSENTIAL FACILITY
3 DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AW103-WST-TE-303	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-304	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-305	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-306	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-307	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-308	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-309	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-310	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-311	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-312	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-313	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-314	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-315	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-316	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-317	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AW103-WST-TE-318	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
8	AW03A-WT-ZT-205	TRANSFER PUMP SUCTION INLET POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	NA					3		N
8	AW03A-WT-ZS-206	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	NA					3		N
8	AW03A-WT-ZS-207	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	NA					3		N
[redacted]																		
6	AW104-WST-P-01	AW104 MIXER PUMP #1		GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					3		N
6	AW104-WST-M-01	AW104 MIXER PUMP #1 MOTOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	AW104-WST-M-01A	AW104 MIXER PUMP #1 TURNTABLE MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
6	AW04A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	AW104-WST-P-02	AW104 MIXER PUMP #2	241-AW	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					3		N
6	AW104-WST-M-02	AW104 MIXER PUMP #2 MOTOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-3, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	AW104-WST-M-02A	AW104 MIXER PUMP #2 TURNTABLE MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AW04A-WT-P-01	AW104 TRANSFER PUMP	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	API 610					3		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AW04A-WT-M-01	AW104 TRANSFER PUMP MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AW04A-WT-M-01A	AW104 TRANSFER PUMP VARIABLE SUCTION POSITION MOTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-3, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AW04-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-MOV-101	AW104 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AW04A-WT-MOV-102	AW104 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AW04A-WT-MOV-103	AW104 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AW04A-WT-MOV-104	AW104 WASTE VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AW04A-WT-FV-112	AW104 WASTE FLOW VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AW04A-WT-V-106	AW104 DILUENT/FLUSH CHECK VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1				400 DEGREE F		3		Y
8	AW104-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT, LOSS OF CCTV PURGE - IGNITION SOURCE	PC1						1		N
8	AW104-WST-ZS-202	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #1)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-ZS-203	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #1)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-VT-204	MIXER PUMP #1BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATUARE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-ZS-209C	MIXER PUMP #1TURNTABLE CCW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-VT-208	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PY-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PY-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AW104-WST-ZS-212	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #2)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-ZS-213	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #2)	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW-104-WST-VT-218	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-ZS-219C	MIXER PUMP#2 TURNTABLE CCW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-ZT-220	MIXER PUMP #2 TURNTABLE ANGLE POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PE-221	MIXER PUMP #2 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PY-221	MIXER PUMP #2 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PT-221	MIXER PUMP #2 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PE-222	MIXER PUMP #2 DISCHARGE PRESSURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PY-222	MIXER PUMP #2 DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AW104-WST-PT-222	MIXER PUMP #2 DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE. UNDER DEVELOPMENT	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 1)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT	PC1						1		N
0	AW104-EDS-XS-201	NORMAL POWER FAIL TRANSFER SW	241-AW	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA					3		N
6	AW104-WST-TV-01	AW104 CAMERA ASSEMBLY SYSTEM	241-AW	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT	PC1	NEC, NEMA					3		N
8	AW04A-WT-ZS-101	AW04A-WT-MOV-101 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-ZS-102	AW04A-WT-MOV-102 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-ZS-103	AW04A-WT-MOV-103 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-ZS-104	AW04A-WT-MOV-104 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-ZT-212	AW04A-WT-FV-212 POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-ZS-212	AW04A-WT-FV-212 POSITION SWITCHES	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-TE-208	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N

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** = SEISMIC ANCHORING REQUIRED
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2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AW04A-WT-ZS-209	TRANSFER PUMP TRANSFER SWITCH POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSDUCER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-HS-210	TRANSFER PUMP PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-UE-212	FLOW, DENSITY, AND TEMP ELEMENT	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-UT-212	FLOW, DENSITY, AND TEMP TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-UY-212	FLOW, DENSITY, AND TEMP MULTIVARIABLE EQUIPMENT RELAY	241-AW	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
6	AW104-WST-TE-301	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-302	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-303	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-304	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-305	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-306	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-307	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-308	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-309	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-310	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-311	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-312	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-313	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-314	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-315	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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2. UBC, ZONE 2B, ESSENTIAL FACILITY
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PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AW104-WST-TE-316	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-317	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AW104-WST-TE-318	TEMPERATURE ELEMENT	241-AW	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
8	AW04A-WT-ZT-205	TRANSFER PUMP SUCTION INLET POSITION TRANSMITTER	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-ZS-206	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	AW04A-WT-ZS-207	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-AW	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
[redacted]																		
8	AWA-WT-V-101	3-WAY VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 96	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AWA-WT-ZS-101	3-WAY VALVE POSITION SWITCHES	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	AWA-WT-PE-201A	PRESSURE ELEMENT	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AWA-WT-PSH-201A	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AWA-WT-PE-201B	PRESSURE ELEMENT	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AWA-WT-PSH-201B	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
[redacted]																		
8	AWB-WT-V-101	3-WAY VALVE	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 96	450 psig / CS		400°F	2 E 7 RADS (TID)	3		N
8	AWB-WT-ZS-101	3-WAY VALVE POSITION SWITCHES	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	AWB-WT-PE-201A	PRESSURE ELEMENT	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AWB-WT-PSH-201A	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AWB-WT-PE-201B	PRESSURE ELEMENT	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AWB-WT-PSH-201B	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AW	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
[redacted]																		
0	AYICE-EDS-DP-1	AYICE BUILDING DISTRIBUTION PANEL	241-AY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-4		NO SAFETY FUNCTION	PC1						3		Y
0	AYICE-EDS-DP-01	MINI-POWER CENTER	241-AY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-4		NO SAFETY FUNCTION	PC1						3		Y
0	AYICE-EDS-DP-02	MINI-POWER CENTER AY101/AY102	241-AY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-4		NO SAFETY FUNCTION	PC1						3		Y
0	AYICE-VT-AC-01	HVAC UNIT	241-AY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-4		NO SAFETY FUNCTION	PC1						3		Y
0	AY-EDS-XFMR-01	1000 KVA TRANSFORMER	241-AY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-4		NO SAFETY FUNCTION	PC 1						3		Y
6	AYICE-WST-VFD-01	AY101/102 MIXER PUMP #1 VARIABLE FREQUENCY DRIVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1		480V				3		N
6	AYICE-WST-PNL-01	POWER PANEL MIXER PUMP #1	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N

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SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AYICE-WST-VFD-02	AY101/102 MIXER PUMP #2 VARIABLE FREQUENCY DRIVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1		480V				3		N
6	AYICE-WST-PNL-02	POWER PANEL MIXER PUMP #2	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
8	AYICE-WT-VFD-01	AY101/102 TRANSFER PUMP #1 VARIABLE FREQUENCY DRIVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1		480V				3		N
8	AYICE-WT-PNL-01	POWER PANEL TRANSFER PUMP	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
8	AY01A-WT-M-01A	AY101 TRANSFER PUMP ADJUSTABLE SUCTION	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
8	AY02A-WT-M-01A	AY102 TRANSFER PUMP ADJUSTABLE SUCTION	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	AYICE-WST-VFD-01A	AY101/102 TURNTABLE MOTOR #1 VARIABLE FREQUENCY DRIVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1						3		N
6	AY101-WST-MTS-01A	AY101/102 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #1)	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	AYICE-WST-VFD-02A	AY101/102 TURNTABLE MOTOR #2 VARIABLE FREQUENCY DRIVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-4		NO SAFETY FUNCTION	PC1						3		N
6	AY101-WST-MTS-02A	AY101/102 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #2)	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	AY101-WST-MTS-04A	AY101/102 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #4)	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-E-4		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	AY101-WST-P-01	AY101 MIXER PUMP #1	241-AY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610				2 x 10^7 R(TID)	1		N
6	AY101-WST-M-01	AY101 MIXER PUMP #1 MOTOR	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E4, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	AY101-WST-M-01A	AY101 MIXER PUMP #1 TURNTABLE MOTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E4, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
6	AY01A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	AY101-WST-P-02	AY101 MIXER PUMP #2	241-AY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610				2 x 10^7 R(TID)	3		N
6	AY101-WST-M-02	AY101 MIXER PUMP #2 MOTOR	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E4, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	AY101-WST-M-02A	AY101 MIXER PUMP #2 TURNTABLE MOTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E4, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AY01A-WT-P-01	AY101 TRANSFER PUMP	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1	API 610					3		N
8	AY01A-WT-M-01	AY101 TRANSFER PUMP MOTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E4, sh 1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AY01-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-MOV-101	AY101 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			LIMIT MISROUTING OF WASTE		SERVICE WATER ISOLATION PRESSURE BOUNDRY	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-MOV-102	AY101 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			LIMIT MISROUTING OF WASTE		NO SAFETY FUNCTION	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AY01A-WT-MOV-103	AY101 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			LIMIT MISROUTING OF WASTE		NO SAFETY FUNCTION	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AY01A-WT-MOV-104	AY101 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			LIMIT MISROUTING OF WASTE		SERVICE WATER ISOLATION PRESSURE BOUNDRY	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-MOV-105	AY101 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			LIMIT MISROUTING OF WASTE		NO SAFETY FUNCTION	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AY01A-WT-MOV-106	AY101 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			LIMIT MISROUTING OF WASTE		NO SAFETY FUNCTION	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AY01A-WT-FV-212	AY101 WASTE FLOW CONTROL VALVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AY01A-WT-V-106	AY101 DILUENT/FLUSH CHECK VALVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTION	PC1						3		N
8	AY101-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-AY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT, LOSS OF CCTV PURGE - IGNITION SOURCE	PC1						1		N
8	AY101-WST-VT-204	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-ZS-209C	MIXER PUMP #1 TURNTABLE CCW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-VT-208	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-PY-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-PY-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY101-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-VT-218	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-ZS-219C	MIXER PUMP #2 TURNTABLE CCW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY101-WST-ZT-220	MIXER PUMP #2 TURNTABLE ANGLE POSITION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY101-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE, UNDER DEVELOPMENT	241-AY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 1)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	ISA					1		N
0	AY101-EDS-XS-201	NORMAL POWER FAIL TRANSFER SW	241-AY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA					3		N
6	AY101-WST-TV-01	AY101 CAMERA ASSEMBLY SYSTEM	241-AY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT	PC1	NEC, NEMA					1		N
8	AY01A-WT-ZS-101	AY02A-WT-MOV-101 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-102	AY01A-WT-MOV-102 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-103	AY01A-WT-MOV-103 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-104	AY01A-WT-MOV-104 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-105	AY01A-WT-MOV-105 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-106	AY01A-WT-MOV-106 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZT-212	AY01A-WT-FV-112 POSITION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-212	AY01A-WT-FV-112 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-TE-208	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSDUCER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-HS-210	PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-UE-212	FLOW, DENSITY, AND TEMP ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-UT-212	FLOW, DENSITY, AND TEMP TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-UY-212	FLOW, DENSITY, AND TEMP MULTIVARIABLE TRANSDUCER	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PE-214A	PRESSURE ELEMENT	241-AY	SS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PSH-214A	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AY	SS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PE-214B	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AY	SS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PSH-214B	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AY	SS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY101-WST-TE-301	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-302	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-303	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-304	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-305	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-306	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-307	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-308	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-309	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-310	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-311	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-312	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-313	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-314	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-315	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-316	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-317	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-318	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-301A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-302A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-303A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-304A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-305A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-306A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-307A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-308A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-309A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-310A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY101-WST-TE-311A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-312A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-313A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-314A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-315A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-316A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-317A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-318A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-301B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-302B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-303B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-304B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-305B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-306B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-307B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-308B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-309B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-310B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-311B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-312B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-313B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-314B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-315B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-316B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-317B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-318B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-301C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-302C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

TBR = TO BE REVIEWED
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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY101-WST-TE-303C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-304C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-305C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-306C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-307C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-308C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-309C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-310C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-311C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-312C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-313C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-314C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-315C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-316C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-317C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-318C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-301D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-302D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-303D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-304D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-305D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-306D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-307D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-308D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-309D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-310D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-311D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-312D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY101-WST-TE-313D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-314D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-315D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-316D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-317D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY101-WST-TE-318D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-P-01	AY102 MIXER PUMP #1	241-AY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610				2 x 10^7 R(TID)	1		N
6	AY102-WST-M-01	AY102 MIXER PUMP #1 MOTOR	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E4, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	AY102-WST-M-01A	AY102 MIXER PUMP #1 TURNTABLE MOTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E4, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
6	AY01A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	AY102-WST-P-02	AY102 MIXER PUMP #2	241-AY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610				2 x 10^7 R(TID)	3		N
6	AY102-WST-M-02	AY102 MIXER PUMP #2 MOTOR	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E4, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
8	AY102-WST-M-02A	AY102 MIXER PUMP #2 TURNTABLE MOTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E4, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AY01A-WT-P-01	AY102 TRANSFER PUMP	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1	API 610					3		N
8	AY01A-WT-M-01	AY102 TRANSFER PUMP MOTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E4, sh 1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	AY01-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-MOV-101	AY102 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-MOV-102	AY102 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-MOV-103	AY102 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-MOV-104	AY102 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-MOV-105	AY102 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-MOV-106	AY102 WASTE VALVE	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	AY01A-WT-FV-212	AY102 WASTE FLOW CONTROL VALVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTION	PC1	ASME/B16.34/1998	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	AY01A-WT-V-106	AY102 DILUENT/FLUSH CHECK VALVE	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTION	PC1						3		N
8	AY102-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-AY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT, LOSS OF CCTV PURGE - IGNITION SOURCE	PC1						1		N
8	AY102-WST-VT-204	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AY102-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-ZS-209C	MIXER PUMP #1 TURNTABLE CCW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-VT-208	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-PY-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-PY-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	AY102-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-VT-218	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-ZS-219C	MIXER PUMP #2 TURNTABLE CCW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-ZT-220	MIXER PUMP #2 TURNTABLE ANGLE POSITION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE, UNDER DEVELOPMENT	241-AY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 1)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	ISA					1		N
0	AY102-EDS-XS-201	NORMAL POWER FAIL TRANSFER SW	241-AY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA					3		N
6	AY102-WST-TV-01	AY102 CAMERA ASSEMBLY SYSTEM	241-AY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT	PC1	NEC, NEMA					1		N
8	AY01A-WT-ZS-101	AY01A-WT-MOV-101 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N

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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AY01A-WT-ZS-102	AY01A-WT-MOV-102 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-103	AY01A-WT-MOV-103 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-104	AY01A-WT-MOV-104 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-105	AY01A-WT-MOV-105 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-106	AY01A-WT-MOV-106 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZT-212	AY01A-WT-FV-112 POSITION TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-ZS-212	AY01A-WT-FV-112 POSITION SWITCHES	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-TE-206	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSDUCER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-HS-210	PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-UE-212	FLOW, DENSITY, AND TEMP ELEMENT	241-AY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-UT-212	FLOW, DENSITY, AND TEMP TRANSMITTER	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-UY-212	FLOW, DENSITY, AND TEMP MULTIVARIABLE TRANSDUCER	241-AY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PE-214A	PRESSURE ELEMENT	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PSH-214A	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PE-214B	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PSH-214B	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-AY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh5		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	AY01A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
8	AY01A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-AY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1						3		N
6	AY102-WST-TE-301	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-302	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-303	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-304	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY102-WST-TE-305	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-306	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-307	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-308	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-309	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-310	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-311	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-312	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-313	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-314	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-315	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-316	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-317	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-318	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-301A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-302A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-303A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-304A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-305A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-306A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-307A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-308A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-309A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-310A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-311A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-312A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-313A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-314A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY102-WST-TE-315A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-316A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-317A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-318A	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-301B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-302B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-303B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-304B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-305B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-306B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-307B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-308B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-309B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-310B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-311B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-312B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-313B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-314B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-315B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-316B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-317B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-318B	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-301C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-302C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-303C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-304C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-305C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	AY102-WST-TE-306C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY102-WST-TE-307C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-308C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-309C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-310C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-311C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-312C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-313C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-314C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-315C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-316C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-317C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-318C	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-301D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-302D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-303D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-304D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-305D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-306D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-307D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-308D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-309D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-310D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-311D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-312D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-313D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-314D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-315D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-316D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	AY102-WST-TE-317D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	AY102-WST-TE-318D	TEMPERATURE ELEMENT	241-AY	SS (LTR CHG-0000281)			ESW-521-P-6, sh5		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
[illegible]																		
1	AZ-K1-9-2	HEME	241AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ-K1-8-2	CONDENSER	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ-CW-P-2A	GYCOL RECIRC PUMP	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P15,Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ-CW-P-2B	GYCOL RECIRC PUMP	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12,Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ-CW-R-2	GYCOL CHILLER	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P15, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ-PC -SP-1	SEAL POT	241-AZ-702	SC (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P13, Sht 1		DRAIN PATH FROM VENT FACILITY	PC3						3		N
1	AZ-K1-5-1A	EXHAUST FAN	241-AZ-702	SC (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P11, Sht 1		TANK FLOW	PC3						1		N
1	AZ-K1-5-1B	EXHAUST FAN	241-AZ-702	SC (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P11, Sht 1		TANK FLOW	PC3						1		N
1	AE-AZK1-1	ISOKKINETIC SAMPLE PROBLE	PRIMARY VENT EXHAUST STACK	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P11, Sht 1		HNF-SD-WM-TSR-006 Rev. 1, LC0 3.1.4	PC3						3		N
1	AE-AZK1-2	ISOKKINETIC SAMPLE PROBLE	PRIMARY VENT EXHAUST STACK	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P11, Sht 1		HNF-SD-WM-TSR-006	PC3						3		N
1	PDT-AZK	CONDENSER DIFFERENTIAL PRESSURE TRANSMITTER	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		HNF-SD-WM-TSR-006	PC1						3		N
1	PDE-AZK	CONDENSER DIFFERENTIAL PRESSURE ELEMENT	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	RE-AZK109-2	HEME RAD ELEMENT	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	RIAS-AZK109-2	HEME RAD INDICATING ALARM SWITCH	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	PDT-AZK-109-2B	CONDENSER DIFFERENTIAL PRESSURE TRANSMITTER	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	PDE-AZK-109-2B	CONDENSER DIFFERENTIAL PRESSURE ELEMENT	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	MK-AZK109-2A	10" BUTTERFLY VALVE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	MK-AZK108-2A	10" BUTTERFLY VALVE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	MK-AZK108-2B	10" BUTTERFLY VALVE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	TE-AZK-2A	TEMPERATURE ELEMENT, UPSTREAM OF CONDENSER	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	TE-AZK-2B	TEMPERATURE ELEMENT, DOWNSTREAM OF CONDENSER	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	TE-AZCWS-2	TEMPERATURE ELEMENT, DOWNSTREAM OF RECIRC PUMP	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P15, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AY-101-LDE-1	ENCASEMENT LEAK DETECTOR ELEMENT FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AY-101-LDY-1	ENCASEMENT LEAK DETECTOR RELAY FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ101-LDE-2	ENCASEMENT LEAK DETECTOR ELEMENT FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
1	AZ101-LDY-2	ENCASEMENT LEAK DETECTOR RELAY FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AY-102-LDE-1	ENCASEMENT LEAK DETECTOR ELEMENT FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AY-102-LDY-1	ENCASEMENT LEAK DETECTOR RELAY FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ102-LDE-2	ENCASEMENT LEAK DETECTOR ELEMENT FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ102-LDY-2	ENCASEMENT LEAK DETECTOR RELAY FOR CONDENSATE	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ702-LDE-2	PRIMARY VENT CELL SUMP #2 LEAK DETECTOR ELEMENT	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZ702-LDY-2	PRIMARY VENT CELL SUMP #2 LEAK RELAY	241-AZ-702	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZPCSP-LE-1	AZ-PC-SP-2 CONDENSATE SEAL POT LEVEL ELEMENT	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZPCSP-LY-1A	AZ-PC-SP-2 CONDENSATE SEAL POT LEVEL RELAY	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AZPCSP-LY-1B	AZ-PC-SP-2 CONDENSATE SEAL POT LEVEL RELAY	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ESW-521-P12, Sht 1		NO SAFETY FUNCTION	PC1						3		N
1	AY K1-3-1	ANNULUS SUPPLY FAN	241-AY	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01 Sht 1		TANK BUMP	PC2						2		N
	AY K2-3-1	ANNULUS SUPPLY FAN	241-AY	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01 Sht 1		TANK BUMP	PC2						2		N
	AY K1-3-2	ANNULUS EXHAUST FAN	241-AY	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01 Sht 2		FLAMMABLE GAS	PC3						1		N
	AY K2-3-2	ANNULUS EXHAUST FAN	241-AY	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01 Sht 2		FLAMMABLE GAS	PC3						1		N
	AZ K1-3-1	ANNULUS SUPPLY FAN	241-AZ	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01 Sht 1		TANK BUMP	PC2						2		N
	AZ K1-3-2	ANNULUS EXHAUST FAN	241-AZ	SS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01 Sht 2		FLAMMABLE GAS	PC3						1		N
	AY-ESD-DP-BB	MINI POWER ZONE PANEL	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-04		NO SAFETY FUNCTION	PC1						3		N
	AY-VTA-VFD-01	VARIABLE FEQUENCY DRIVE	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-04		NO SAFETY FUNCTION	PC1						3		N
	AY-VTA-VFD-02	VARIABLE FEQUENCY DRIVE	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-04		NO SAFETY FUNCTION	PC1						3		N
	AY-VTA-VFD-03	VARIABLE FEQUENCY DRIVE	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-04		NO SAFETY FUNCTION	PC1						3		N
	AY-VTA-VFD-04	VARIABLE FEQUENCY DRIVE	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-04		NO SAFETY FUNCTION	PC1						3		N
	AZ-VTA-VFD-01	VARIABLE FEQUENCY DRIVE	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-04		NO SAFETY FUNCTION	PC1						3		N
	AZ-VTA-VFD-01	VARIABLE FEQUENCY DRIVE	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-04		NO SAFETY FUNCTION	PC1						3		N
	AY101-PT-01	ANNULUS PRESSURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01		NO SAFETY FUNCTION	PC1						3		N
	AY102-PT-01	ANNULUS PRESSURE TRANSMITTER	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01		NO SAFETY FUNCTION	PC1						3		N
	AY101-FIT-01	ANNULUS FLOW TRANSMITTER	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01		NO SAFETY FUNCTION	PC1						3		N
	AY101-FE-01	ANNULUS FLOW PROBE	241-AY	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AY-01		NO SAFETY FUNCTION	PC1						3		N
	AZ101-PT-01	ANNULUS PRESSURE TRANSMITTER	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01		NO SAFETY FUNCTION	PC1						3		N

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* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
	AZ102-PT-01	ANNULUS PRESSURE TRANSMITTER	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01		NO SAFETY FUNCTION	PC1						3		N
	AZ101-FIT-01	ANNULUS FLOW TRANSMITTER	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01		NO SAFETY FUNCTION	PC1						3		N
	AZ102-FIT-02	ANNULUS FLOW TRANSMITTER	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01		NO SAFETY FUNCTION	PC1						3		N
	AZ101-FE-01	ANNULUS FLOW PROBE	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01		NO SAFETY FUNCTION	PC1						3		N
	AZ102-FE-02	ANNULUS FLOW PROBE	241-AZ	GS (HNF-SD-WM-SAR-067, Rev. 1F)			ES-AZ-01		NO SAFETY FUNCTION	PC1						3		N
[redacted]																		
0	C6647P (NEW)	1500 KVA TRANSFORMER	241-SY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E6, Sh2		NO SAFETY FUNCTION	PC 1						3		N
0	C6648P (NEW)	1500 KVA TRANSFORMER	241-SY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E6, Sh2		NO SAFETY FUNCTION	PC 1						3		N
0	SYICE-EDS-DP-01	SY ICE BUILDING ELECTRICAL DISTRIBUTION PANEL	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E6, Sh1		NO SAFETY FUNCTION	PC 1		480V		NEMA 12		3		N
6	SYICE-WST-VFD-01	SY101/102/103 MIXER PUMP #1 VARIABLE FREQUENCY DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1		480V				3		N
6	SYICE-WST-PNL-01	POWER PANEL MIXER PUMP #1	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
6	SYICE-WST-VFD-02	SY101/102/103 MIXER PUMP #2 VARIABLE FREQUENCY DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1		480V				3		N
6	SYICE-WST-PNL-02	POWER PANEL MIXER PUMP #2	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
8	SYICE-WT-VFD-01	SY101/102/103 TRANSFER PUMP VARIABLE FREQUENCY DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1		480V				3		N
8	SYICE-WST-PNL-01	POWER PANEL TRANSFER PUMP	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 1		3		N
8	SY01A-WT-M-01A	SY101 TRANSFER PUMP ADJUSTABLE SUCTION	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
8	SY02A-WT-M-01A	SY102 TRANSFER PUMP ADJUSTABLE SUCTION	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
8	SY03A-WT-M-01A	SY103 TRANSFER PUMP ADJUSTABLE SUCTION	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SYICE-WST-VFD-01A	SY101/102/103 TURNTABLE MOTOR #1 VARIABLE FREQUENCY DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1						3		N
6	SY101-WST-MTS-01A	SY101/102/103 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #1)	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SY102-WST-MTS-01A	SY101/102/103 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #1)	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SYICE-WST-VFD-02A	SY101/102/103 TURNTABLE MOTOR #1 VARIABLE FREQUENCY DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1						3		N
6	SY101-WST-MTS-02A	SY101/102/103 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #1)	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SY102-WST-MTS-02A	SY101/102/103 MANUAL TRANSFER SWITCH TURNABLE DRIVE (MIXER PUMP #1)	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
0	SYICE-VT-AC-01	HVAC	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V				3		N
6	SY101-WST-P-01	SY101 MIXER PUMP #1	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					3		N
6	SY101-WST-M-01	SY101 MIXER PUMP #1 MOTOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V 30		NEMA-MG-1		3		N

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	SY101-WST-M-01A	SY101 MIXER PUMP #1 TURNTABLE MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
6	SY101-WST-MTS-01A	SY101 MANUAL TRANSFER SWITCH TURNABLE DRIVE MIXER PUMP #1	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SY01A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	SY101-WST-P-02	SY101 MIXER PUMP #2	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					1		N
6	SY101-WST-M-02	SY101 MIXER PUMP #2 MOTOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V 30		NEMA-MG-1		1		N
6	SY101-WST-M-02A	SY101 MIXER PUMP #2 TURNTABLE MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
6	SYICE-EDS-DP-SY101//103	MINI POWER CENTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	208/120 VAC		NEMA-1		3		N
6	SY101-WST-MTS-02A	SY101 MANUAL TRANSFER SWITCH TURNABLE DRIVE MIXER PUMP #2	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
8	SY01A-WT-P-01	SY101 TRANSFER PUMP	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1	API 610					3		N
8	SY01A-WT-M-01	SY101 TRANSFER PUMP MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
8	SY01A-WT-M-01A	SY101 VARIABLE SUCTION POSITION MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
8	SY01A-WT-CP-01A	SY101 VARIABLE SUCTION POSITION CONTROL PANEL	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
8	SY01A-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-MOV-101	SY101 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-MOV-102	SY101 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-MOV-103	SY101 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-MOV-104	SY101 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-FV-212	SY101 WASTE FLOW VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	SY01A-WT-V-106	SY101 DILUENT/FLUSH CHECK VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						1		N
8	SY101-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT, LOSS OF CCTV PURGE - IGNITION SOURCE	PC1						1		N
8	SY101-WST-ZS-202	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #1)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-ZS-203	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #1)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-VT-204	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	SY101-WST-ZS-209C	MIXER PUMP #1 TURNTABLE CCW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY101-WST-VT-208	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY101-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY101-WST-PY-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY101-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY101-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY101-WST-PY-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY101-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
6	SY101-WST-ZS-212	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #2)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-ZS-213	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #2)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-ZS-219C	MIXER PUMP #2 TURNTABLE CCW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-ZT-220	MIXER PUMP #2 TURNTABLE ANGLE POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY101-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE, UNDER DEVELOPMENT	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						1		N
0	SY101-EDS-XS-201	NORMAL POWER FAIL TRANSFER SW	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA					3		N
6	SY101-WST-TV-01	SY101 CAMERA ASSEMBLY	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA					1		N
8	SY01A-WT-ZS-101	SY01A-WT-MOV-101 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-102	SY01A-WT-MOV-102 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-103	SY01A-WT-MOV-103 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-104	SY01A-WT-MOV-104 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N

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* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	SY01A-WT-ZT-212	SY01A-WT-FV-212 POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-212	SY01A-WT-FV-212 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-207	SY01A-WT-MOV-104 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-TE-208	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-209	TRANSFER PUMP TRANSFER SWITCH POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE EQUIPMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE EQUIPMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-HS-210	TRANSFER PUMP PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-UE-212	FLOW, DENSITY, AND TEMP ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
0	SY01A-WT-UT-212	FLOW, DENSITY, AND TEMP TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-UY-212	FLOW, DENSITY, AND TEMP MULTIVARIABLE EQUIPMENT RELAY	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
8	SY01A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	SY101-WST-TE-301	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-302	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-303	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-304	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-305	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-306	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-307	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-308	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-309	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-310	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-311	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	SY101-WST-TE-312	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-313	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-314	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-315	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-316	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-317	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY101-WST-TE-318	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
8	SY01A-WT-ZT-205	TRANSFER PUMP SUCTION INLET POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-206	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-207	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-P-01	SY102 MIXER PUMP #1	241-SYDILUENT AND FLUSH SYSTEM	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					3		N
6	SY102-WST-M-01	SY102 MIXER PUMP #1 MOTOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V 30		NEMA-MG-1		3		N
6	SY102-WST-MTS-01	SY102 MANUAL TRANSFER SWITCH MIXER PUMP #1	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SY102-WST-M-01A	SY102 MIXER PUMP #1 TURNTABLE MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
6	SY102-WST-MTS-01A	SY102 MANUAL TRANSFER SWITCH TURNABLE DRIVE MIXER PUMP #1	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SY01A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	SY102-WST-P-02	SY102 MIXER PUMP #2	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					1		N
6	SY102-WST-M-02	SY102 MIXER PUMP #2 MOTOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V 30		NEMA-MG-1		1		N
6	SY102-WST-MTS-02	SY102 MANUAL TRANSFER SWITCH MIXER PUMP #2	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
6	SY102-WST-M-02A	SY102 MIXER PUMP #2 TURNTABLE MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
6	SY102-WST-MTS-02A	SY102 MANUAL TRANSFER SWITCH TURNABLE DRIVE MIXER PUMP #2	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
8	SY01A-WT-P-01	SY102 TRANSFER PUMP	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh5		NO SAFETY FUNCTIONS	PC1	API 610					3		N
8	SY01A-WT-M-01	SY102 TRANSFER PUMP MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
8	SY01A-WT-M-01A	SY102 VARIABLE SUCTION POSITION MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
8	SY01A-WT-CP-01A	SY102 VARIABLE SUCTION POSITION CONTROL PANEL	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V 30		NEMA-MG-1		3		N
8	SY01A-WT-MTS-01	SY102 MANUAL TRANSFER SWITCH (TRANSFER PUMP)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	600V		NEMA 3R		3		N
8	SY01A-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N

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2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	SY01A-WT-MOV-101	SY102 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-MOV-102	SY102 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-MOV-103	SY102 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-MOV-104	SY102 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY01A-WT-FV-212	SY102 WASTE FLOW VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	SY01A-WT-V-106	SY102 DILUENT/FLUSH CHECK VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						1		N
8	SY102-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT, LOSS OF CCTV PURGE - IGNITION SOURCE	PC1						1		N
8	SY102-WST-ZS-202	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #1)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-ZS-203	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #1)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-VT-204	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-ZS-209C	MIXER PUMP #1 TURNTABLE CCW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY102-WST-VT-208	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY102-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY102-WST-PY-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY102-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY102-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY102-WST-PY-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSDUCER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY102-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
6	SY102-WST-ZS-212	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #2)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-ZS-213	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #2)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	SY102-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-ZS-219C	MIXER PUMP #2 TURNTABLE CCW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY102-WST-ZT-220	MIXER PUMP #2 TURNTABLE ANGLE POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
	SY102-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE, UNDER DEVELOPMENT	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						1		N
0	SY102-EDS-XS-201	NORMAL POWER FAIL TRANSFER SW	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA					3		N
6	SY102-WST-TV-01	SY102 CAMERA ASSEMBLY	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA					1		N
8	SY01A-WT-ZS-101	SY01A-WT-MOV-101 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-102	SY01A-WT-MOV-102 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-103	SY01A-WT-MOV-103 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-104	SY01A-WT-MOV-104 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZT-212	SY01A-WT-FV-212 POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-212	SY01A-WT-FV-212 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-207	SY01A-WT-MOV-104 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-TE-208	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-209	TRANSFER PUMP TRANSFER SWITCH POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE EQUIPMENT-RELAY	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE EQUIPMENT-RELAY	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-HS-210	TRANSFER PUMP PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-UE-212	FLOW, DENSITY, AND TEMP ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
0	SY01A-WT-UT-212	FLOW, DENSITY, AND TEMP TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-UY-212	FLOW, DENSITY, AND TEMP MULTIVARIABLE EQUIPMENT RELAY	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
8	SY01A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	SY102-WST-TE-301	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-302	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-303	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-304	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-305	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-306	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-307	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-308	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-309	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-310	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-311	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-312	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-313	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-314	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-315	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-316	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-317	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
6	SY102-WST-TE-318	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2×10^7 R(TID)	1		N
8	SY01A-WT-ZT-205	TRANSFER PUMP SUCTION INLET POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-206	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY01A-WT-ZS-207	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
0	SYICE-EDS-DP-02	MINI-POWER CENTER	241-SY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-6		NO SAFETY FUNCTION	PC1						3		Y
0	SYICE-EDS-DP-03	MINI-POWER CENTER	241-SY	GS (HNF-SD-WM-SEL-040 REV.4)			ESW-521-E-6		NO SAFETY FUNCTION	PC1						3		Y

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3. DOE-STD-1020

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	SY103-WST-P-01	SY103 MIXER PUMP #1	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					3		N
6	SY103-WST-M-01	SY103 MIXER PUMP #1 MOTOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	SY103-WST-M-01A	SY103 MIXER PUMP #1 TURNTABLE MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
6	SY03A-WT-PRV-105	TRANSFER PUMP PRESSURE RELIEF VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	SY103-WST-P-02	SY103 MIXER PUMP #2	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	API 610					3		N
6	SY103-WST-M-02	SY103 MIXER PUMP #2 MOTOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-E-6, sh1		NO SAFETY FUNCTION	PC1	379, -384, -603 (HNF-PRO-704) - TBR	480V		NEMA-MG-1		3		N
6	SY103-WST-M-02A	SY103 MIXER PUMP #2 TURNTABLE MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	SY03A-WT-P-01	SY103 TRANSFER PUMP	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1	API 610					3		N
8	SY03A-WT-M-01	SY103 TRANSFER PUMP MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	SY03A-WT-M-01A	SY103 TRANSFER PUMP ADJUSTABLE INDEXING MOTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-E-6, sh1		NO SAFETY FUNCTIONS	PC1	NEC, NEMA (HNF-PRO-704)	480V		NEMA-MG-1		3		N
8	SY03-WT-PSE-226	TRANSFER PUMP DISCHARGE RUPTURE DISK	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
8	SY03A-WT-MOV-101	SY103 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY03A-WT-MOV-102	SY103 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY03A-WT-MOV-103	SY103 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY03A-WT-MOV-104	SY103 WASTE VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P-6, sh4		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	1		N
8	SY03A-WT-FV-212	SY103 WASTE FLOW CONTROL VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS		400 DEGREE F	2 E 7 RADS (TID)	3		N
8	SY03A-WT-V-106	SY103 DILUENT/FLUSH CHECK VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
8	SY103-WST-XS-201	PURGE FAIL SWITCH FOR CCTV	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		LOSS OF CCTV PURGE - IGNITION SOURCE	PC1						1		N
8	SY103-WST-ZS-202	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP#1)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY103-WST-ZS-203	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #1)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-VT-204	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-TE-205	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-TE-206	MIXER PUMP #1 MOTOR WINDING TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-TE-207	MIXER PUMP #1 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-ZS-209A	MIXER PUMP #1 TURNTABLE CCW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-ZS-209B	MIXER PUMP #1 TURNTABLE CW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-ZS-209C	MIXER PUMP #1 TURNTABLE CCW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-ZS-209D	MIXER PUMP #1 TURNTABLE CW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N

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PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	SY103-WST-ZT-210	MIXER PUMP #1 TURNTABLE ANGLE POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
8	SY103-WST-VT-208	MIXER PUMP #1 BEARING VIBRATION TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY103-WST-PE-211	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY103-WST-PT-211	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY103-WST-PE-212	MIXER PUMP #1 DISCHARGE PRESSURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
8	SY103-WST-PT-212	MIXER PUMP #1 DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1						3		N
6	SY103-WST-ZS-212	TRANSFER SWITCH POSITION SWITCH (MIXER PUMP #2)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-ZS-213	TRANSFER SWITCH POSITION SWITCH (TURNTABLE MIXER PUMP #2)	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-VT-214	MIXER PUMP #2 BEARING VIBRATION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-TE-215	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-TE-216	MIXER PUMP #2 MOTOR WINDING TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-TE-217	MIXER PUMP #2 BEARING TEMPERATURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-ZS-219A	MIXER PUMP #2 TURNTABLE CCW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-ZS-219B	MIXER PUMP #2 TURNTABLE CW POS SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-ZS-219C	MIXER PUMP #2 TURNTABLE CCW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-ZS-219D	MIXER PUMP #2 TURNTABLE CW LIMIT SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-ZT-220	MIXER PUMP #2 TURNTABLE ANGLE POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						3		N
6	SY103-WST-UT-250	IN-TANK WASTE PROPERTIES PROBE, UNDER DEVELOPMENT	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		NO SAFETY FUNCTIONS	PC1						1		N
0	SY103-EDS-XS-201	NORMAL POWER FAIL	241-SY	GS (LTR CHG-0000281)			ESW-521-P-6, sh3		NO SAFETY FUNCTION	PC1	NEC, NEMA					3		N
6	SY103-WST-TV-01	SY103 CAMERA ASSEMBLY	241-SY	GS (HNF-SD-WM-TSR-006 REV. 1 AC 5.10, CLASS 1, DIV. 2)			ESW-521-P-6, sh3		IN-TANK EQUIPMENT	PC1	NEC, NEMA					1		N
8	SY03A-WT-ZS-101	SY03A-WT-MOV-101 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-ZS-102	SY03A-WT-MOV-102 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-ZS-103	SY03A-WT-MOV-103 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-ZS-104	SY03A-WT-MOV-104 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-ZT-212	SY03A-WT-FV-212 POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-ZS-212	SY03A-WT-FV-212 POSITION SWITCHES	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-TE-208	TRANSFER PUMP MOTOR TEMPERATURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-ZS-209	TRANSFER PUMP TRANSFER SWITCH POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N

TBR = TO BE REVIEWED
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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG (SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	SY03A-WT-PE-210	TRANSFER PUMP DISCHARGE PRESSURE ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-PY-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSDUCER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-PT-210	TRANSFER PUMP DISCHARGE PRESSURE TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-HS-210	PRESSURE TRANSMITTER CALIBRATION ADJUSTMENT	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-FE-211	TRANSFER PUMP DISCHARGE FLOW ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-FIT-211	TRANSFER PUMP DISCHARGE FLOW TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-FY-211	TRANSFER PUMP DISCHARGE REVERSE FLOW DETECTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-UE-212	FLOW, VISCOSITY, DENSITY, AND TEMP ELEMENT	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-UT-212	FLOW, VISCOSITY, DENSITY, AND TEMP TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-UY-212	FLOW, VISCOSITY, DENSITY, AND TEMP MULTIVARIABLE EQUIPMENT TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-PE-215	PRESSURE ELEMENT, TRANSFER PUMP RELIEF	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
8	SY03A-WT-PSH-215	PRESSURE SWITCH, TRANSFER PUMP RELIEF	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-6, sh4		NO SAFETY FUNCTION	PC1						3		N
6	SY103-WST-TE-301	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-302	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-303	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-304	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-305	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-306	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-307	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-308	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-309	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-310	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-311	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-312	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-313	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-314	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-315	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-316	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N

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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3 DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
6	SY103-WST-TE-317	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	NA			300°F	2 x 10^7 R(TID)	1		N
6	SY103-WST-TE-318	TEMPERATURE ELEMENT	241-SY	SS (LTR CHG-0000281)			ESW-521-P-6, sh4		TEMPERATURE MONITORING AND ALARM	PC2	N			300°F	2 x 10^7 R(TID)	1		N
8	SY03A-WT-ZT-205	TRANSFER PUMP SUCTION INLET POSITION TRANSMITTER	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03A-WT-ZS-206	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
8	SY03+C929A-WT-ZS-207	TRANSFER PUMP SUCTION INLET POSITION SWITCH	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-6, sh4		NO SAFETY FUNCTIONS	PC1						3		N
[redacted]																		
8	SYA-WT-PE-202A	PRESSURE ELEMENT, BACKFLOW PREVENTION	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	SYA-WT-PSH-202A	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	SYA-WT-PE-202B	PRESSURE ELEMENT, BACKFLOW PREVENTION	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	SYA-WT-PSH-202B	PRESSURE SWITCH HIGH, BACKFLOW PREVENTION	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		(HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)	PC2						1		N
8	SYA-WT-V-101	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-101	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-102	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-102	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-103	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-103	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-104	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-104	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-105	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-105	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-106	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-106	2-WAY VALVE POSITION SWITCHES	241-SY	GS SUPPORTING SC FUNCTION (HNF-SD-WM-TSR-006 REV. 1 LCO 3.1.2)			ESW-521-P8, sh1		SERVICE WATER ISOLATION PRESSURE BOUNDRY	PC3	ASME/B16.34/1998	450 psig / CS			2 E 7 RADS (TID)	1		N
8	SYA-WT-V-107	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-107	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-108	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-108	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-109	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/1998	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N

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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	SYA-WT-ZS-109	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-110	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-110	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-111	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-111	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-112	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-112	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYA-WT-V-113	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYA-WT-ZS-113	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
[redacted]																		
8	SYB-WT-V-101	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-101	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-102	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-102	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-103	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-103	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-104	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-104	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-105	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-105	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-106	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-106	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-107	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-107	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-108	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-108	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
8	SYB-WT-V-109	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-109	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N

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** = SEISMIC ANCHORING REQUIRED
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2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	SYB-WT-V-110	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P8, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		N
8	SYB-WT-ZS-110	2-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P8, sh1		NO SAFETY FUNCTION	PC1						3		N
[redacted]																		
22	SY-RW-BFP-102	REDUCED PRESSURE BACKFLOW PREVENTOR	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-TI-101	POTABLE WATER TEMPERATURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh3		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-HTR-02	ELECTRIC WATER HEATER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		1000 kw, 150 DEGF @ 60 GPM			NONE	3		N
22	SY521-CHEMB-MX-01	STATIC IN-LINE MIXER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FE-201	DILUENT AND FLUSH SYSTEM RAW WATER FLOW ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FIT-201	DILUENT AND FLUSH SYSTEM RAW WATER FLOW INDICATING TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh4		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FC-209	METERING PUMP FLOW CONTROLLER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FC-210	METERING PUMP FLOW CONTROLLER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-P-03	METERING PUMP	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		10 Hp, 0-70 GPM			NONE	3		N
22	SY521-CHEMB-P-04	METERING PUMP	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		10 Hp, 0-70 GPM			NONE	3		N
22	SY521-CHEMB-PCV-211	METERING PUMP P-03 OUTLET PRESSURE CONTROL VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-PCV-212	METERING PUMP P-04 OUTLET PRESSURE CONTROL VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-VFD-03	METERING PUMP #1 VARIABLE SPEED DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-VFD-04	METERING PUMP #2 VARIABLE SPEED DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-LSH-213	DILUENT AND FLUSH SUMP LEVEL SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-LE-213	DILUENT AND FLUSH SUMP LEVEL ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-P-05	DILUENT/FLUSH TANK AGITATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		50 GPM, 1/2 Hp			NONE	3		N
22	SY521-CHEMB-PI-207	RECIRCULATION PUMP DISCHARGE PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-HS-214	DILUENT/FLUSH TANK RECIRCULATION PUMP ON/OFF SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-LSLL 215	DILUENT/FLUSH TANK LEVEL SWITCH LOW LOW	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-CE-216	DILUENT/FLUSH TANK CONDUCTIVITY ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-CIT-216	DILUENT/FLUSH TANK CONDUCTIVITY INDICATING TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-TE-217	DILUENT/FLUSH TANK TEMPERATURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-TIT-217	DILUENT FLUSH TANK TEMPERATURE INDICATING TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-TK-001	DILUENT/FLUSH TANK	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		20,000 GAL., DESIGN PRESS. -			NONE	3		N

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2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	SY521-CHEMB-MOV 101	RAW WATER AND DILUENT/FLUSH TANK 3-WAY VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-ZS-218	RAW WATER AND DILUENT/FLUSH TANK 3-WAY VALVE LIMIT SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-LE-219	DILUENT/FLUSH TANK LEVEL ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-LIT-219	DILUENT/FLUSH TANK LEVEL INDICATING TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-LSHH-220	DILUENT/FLUSH TANK LEVEL SWITCH HIGH HIGH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-TC-221	DILUENT/FLUSH TANK HEATER TEMPERATURE CONTROLLER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-HTR-01	DILUENT/FLUSH TANK HEATER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-MOV 102	DILUENT/FLUSH TANK OUTLET ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-ZS-222	DILUENT/FLUSH TANK ISOLATION VALVE POSITION SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-PI-223	RAW WATER AND CAUSTIC/DILUENT PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-P-01	DILUENT/FLUSH PUMP #1	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		480V-60 Hp			NONE	3		N
22	SY521-CHEMB-P-02	DILUENT/FLUSH PUMP #2	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		480V-60 Hp			NONE	3		N
22	SY521-CHEMB-VFD-01	DILUENT/FLUSH PUMP #1 VARIABLE SPEED DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-VFD-02	DILUENT/FLUSH PUMP #2 VARIABLE SPEED DRIVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-PI-225	DILUENT/FLUSH PUMP #1 OUTLET PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-PI-224	DILUENT/FLUSH PUMP #2 OUTLET PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-PIT-226	DILUENT/FLUSH PUMP OUTLET PRESSURE INDICATING TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-TT-227	DILUENT/FLUSH PUMP OUTLET TEMPERATURE TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-TE-227	DILUENT/FLUSH PUMP OUTLET TEMPERATURE ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FE-202	DILUENT/FLUSH PUMP OUTLET FLOW ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FIT-202	DILUENT/FLUSH PUMP OUTLET FLOW INDICATING TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FQI-202	DILUENT/FLUSH PUMP OUTLET FLOW INDICATING TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FY-202	DILUENT/FLUSH PUMP OUTLET REVERSE FLOW SIGNAL	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-FV-202	DILUENT/FLUSH FLOW VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-ZS-202	DILUENT/FLUSH FLOW VALVE POSITION SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-ZT-202B	DILUENT/FLUSH FLOW VALVE POSITION TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-V-002A	DILUENT/FLUSH SYSTEM CHECK VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-MOV 103	DILUENT/FLUSH ISOLATION VALVE (FAIL CLOSE)	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N

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PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	SY521-CHEMB-ZS-103	DILUENT/FLUSH ISOLATION VALVE POSITION SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-MOV 104	DILUENT/FLUSH ISOLATION VALVE (FAIL CLOSE)	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh4		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY521-CHEMB-ZS-104	DILUENT/FLUSH ISOLATION VALVE POSITION SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh4		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-172	RAW WATER MANUAL ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh3		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-173	PRESSURE INDICATOR ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PI-104	RAW WATER PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-STR-101	RAW WATER STRAINER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-M-108	STRAINER MOTOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PDISH-103	RAW WATER STRAINER PRESSURE DIFFERENTIAL INDICATING SWITCH HIGH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-175	WATER STRAINER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-177	WATER STRAINER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-W-V-176	RAW WATER STRAINER PRESSURE DIFFERENTIAL SWITCH EQUALIZING VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PCV-101	STRAINER OUTLET PRESSURE CONTROL VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-174	STRAINER DRAIN MANUAL ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-MOV-107	STRAINER DRAIN MOTOR OPERATED VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-ZS-107	POSITION SWITCH FOR STRAINER DRAIN MOV	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PIT-105	RAW WATER PRESSURE INDICATION TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-178	RAW WATER PIT MANUAL ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PRV-102	RAW WATER PRESSURE RELIEF VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-RE-126	RAW WATER RADIATION ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-RT-126	RAW WATER RADIATION TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-RIAS-126	RAW WATER RADIATION INDICATING ALARM SWITCH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FQI-101	FLOW TOTALIZER FOR RAW WATER TO DILUENT AND FLUSH SYSTEM	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FE-101	FLOW ELEMENT FOR RAW WATER TO DILUENT AND FLUSH SYSTEM	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-POT-V-101	POTABLE WATER MANUAL ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh3		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-POT-V-111	POTABLE WATER HEATER MANUAL ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-POT-HTR-101	POTABLE WATER HEATER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SYPOT-PRV-101	POTABLE WATER HEATER PRESSURE RELIEF VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N

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2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	SY-POT-V-112	POTABLE WATER HEATER DRAIN VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-181	MANUAL ISOLATION VALVE TO FILTERS	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-182	75 MICRON FILTER BYPASS VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FLT-102	75 MICRON FILTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-183	75 MICRON FILTER INLET ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SYRW-V-184	75 MICRON FILTER OUTLET ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-185	FILTER OUTLET CHECK VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PDISH-112	75 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH HIGH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-186	75 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-187	75 MICRON FILTER PRESSURE DIFFERENTIAL SWITCH HIGH EQUALIZING VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-188	75 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-192	THREE WAY VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PI-108	FILTERED WATER PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-193	FILTERED WATER PRESSURE INDICATOR MANUAL ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-TK-101	FILTERED WATER STORAGE TANK	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-190	FILTERED WATER STORAGE TANK ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-191	FILTERED WATER STORAGE TANK AIR CHANGE VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-206	FILTERED WATER STORAGE TANK DRAIN VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FE-113	FILTERED WATER FLOW ELEMENT	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FT-113	FILTERED WATER FLOW TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-202	MIXER PUMP SPARGE RING ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh3		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FLT-103	5 MICRON FILTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-194	5 MICRON FILTERED WATER INLET ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-195	5 MICRON FILTERED WATER OUTLET ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SYRW-FLT-104	5 MICRON FILTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-196	5 MICRON FILTERED WATER INLET ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-197	5 MICRON FILTERED WATER OUTLET ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PDISH-114	5 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH HIGH	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N

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2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	SY-RW-V-198	5 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-200	5 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-199	5 MICRON FILTER PRESSURE DIFFERENTIAL SWITCH EQUALIZING VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-201	MANUAL ISOLATION VALVE FOR MIXER PUMP COLUMN FILL	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-204	PRESSURE CONTROL VALVE PCV-102 ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PI-107	PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PCV-102	PRESSURE CONTROL VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PI-106	PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-203	PRESSURE CONTROL VALVE PCV-102 ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-205	PRESSURE CONTROL VALVE PCV-103 ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PI-109	PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PCV-103	PRESSURE CONTROL VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PI-110	PRESSURE INDICATOR	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-V-206	PRESSURE CONTROL VALVE PCV-103 ISOLATION VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-PRV-102	PRESSURE RELIEF VALVE	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FQI-115	FLOW TOTALIZER FOR MIXER PUMP COLUMN FILL	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-RW-FQI-116	FLOW TOTALIZER FOR MIXER PUMP SPARGE RING	241-SY	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-521-CHEMB-RE-228	RADIATION ELEMENT	241-SY	GS (HNF-SD-WM-SAR-067, REV. 1F)			ESW-521-P-7, sh 4		DETECT AND ALARM RADIATION	PC1					NONE	3		N
22	SY-521-CHEMB-RSH-228	RADIATION SWITCH HIGH	241-SY	GS (HNF-SD-WM-SAR-067, REV. 1F)			ESW-521-P-7, sh 4		DETECT AND ALARM RADIATION	PC1					NONE	3		N
22	SY-521-CHEMB-RAH-228	RADIATION ALARM HIGH	241-SY	GS (HNF-SD-WM-SAR-067, REV. 1F)			ESW-521-P-7, sh 4		DETECT AND ALARM RADIATION	PC1					NONE	3		N
22	SY-521-CHEMB-FQI-230	DILUENT & FLUSH TOTALIZER	241-SY	SS (LTR CHG-0000281, SUPPORTS SS EQUIPMENT)			ESW-521-P-7, sh 4		TOTALIZE AND INDICATE TOTAL FLOW	PC1					NONE	3		N
22	SY-521-CHEMB-FV-201	DILUENT & FLUSH SYSTEM	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7 sh 4		NO SAFETY FUNCTION	PC1					NONE	3		N
22	SY-521-CHEMB-ZT-201	DILUENT & FLUSH SYSTEM RAW WATER POSITION TRANSMITTER	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7 sh 4		NO SAFETY FUNCTION	PC1					NONE	3		N
22	[redacted]																	
8	SY-APA-WT-LDE-201	241-AP-A VALVE PIT LEAK DETECTOR ELEMENT	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		OF LIQUID WASTE AND PROVIDE ALARM OR INTERLOCK	PC2						1		N
8	SY-APA-WT-LDK-201	241-AP-A VALVE PIT LEAK DETECTOR RELAY	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		OF LIQUID WASTE AND PROVIDE ALARM OR INTERLOCK	PC2						1		N
8	APA-WT-LDE-202	TRANSFER LINE SN-634a ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDK-202	TRANSFER LINE SN-634a ENCASEMENT LEAK DETECTOR RELAY	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y

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PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	APA-WT-LDE-203	TRANSFER LINE SN-636a ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDK-203	TRANSFER LINE SN-636a ENCASEMENT LEAK DETECTOR RELAY	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDE-206	TRANSFER LINE SN-637a ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDK-206	TRANSFER LINE SN-637a ENCASEMENT LEAK DETECTOR RELAY	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDE-207	TRANSFER LINE SN-637b ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDK-207	TRANSFER LINE SN-637b ENCASEMENT LEAK DETECTOR RELAY	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDE-205	TRANSFER LINE SN-636c ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDK-205	TRANSFER LINE SN-636c ENCASEMENT LEAK DETECTOR RELAY	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDE-204	TRANSFER LINE SN-636b ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-LDK-204	TRANSFER LINE SN-636b ENCASEMENT LEAK DETECTOR RELAY	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-101	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-101	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-102	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-102	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-103	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	SAPA-WT-ZS-103	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-104	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-104	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-105	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-105	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-106	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-106	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-107	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-107	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-108	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-108	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-109	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-109	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	APA-WT-V-110	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-110	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-111	3-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-111	3-WAY VALVE POSITION SWITCHES	241-SY	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-112	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-112	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-113	2-WAY VALVE	241-SY	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P9, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	APA-WT-ZS-113	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P9, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	APA-WT-V-114	TRANSFER LINE SN-634a ENCASEMENT DRAIN VALVE	241-AP	GS					ENCASEMENT ANNULUS SPACE TO LOW POINT PIT LEAK	PC1						3		Y
8	APA-WT-V-115	TRANSFER LINE SN-636a ENCASEMENT DRAIN VALVE	241-AP	GS			ESW-521-P-9, sh 1		PROVIDE PATH FROM ENCASEMENT ANNULUS SPACE TO LOW POINT PIT LEAK	PC1						3		Y
[redacted]																		
8	AP-WT-LDE-201	241-AP VALVE PIT LEAK DETECTOR ELEMENT	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		OF LIQUID WASTE AND PROVIDE ALARM OR INTERLOCK	PC2						1		Y
8	AP-WT-LDK-201	241-AP VALVE PIT LEAK DETECTOR RELAY	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		OF LIQUID WASTE AND PROVIDE ALARM OR INTERLOCK	PC2						1		Y
8	AP-WT-LDE-202	TRANSFER LINE 2"SL-509 ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-LDK-202	TRANSFER LINE 2"SL-509 ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-LDE-203	TRANSFER LINE 3" SN-610 ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-LDK-203	TRANSFER LINE 3" SN-610 ENCASEMENT LEAK DETECTOR RELAY	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-LDE-204	TRANSFER LINE 3" SN-609 ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-LDK-204	TRANSFER LINE 3" SN-609 ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-LDE-205	TRANSFER LINE 2" SL 510 ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-LDK-205	TRANSFER LINE 2" SL 510 ENCASEMENT LEAK DETECTOR ELEMENT	241-AP	GS (HNF-SD-WM-SEL-040 REV. 4)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-101	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-101	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-102	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-102	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-103	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-103	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-104	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AP-WT-ZS-104	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-105	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-105	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-106	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-106	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-107	2-WAY MOV	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-107	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-108	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-108	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-109	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-109	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-110	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-110	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-111	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-111	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-112	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-112	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-113	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-113	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-114	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-114	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-115	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-115	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-116	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-116	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-117	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-117	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-118	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y

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* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFG/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AP-WT-ZS-118	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-119	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-119	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-120	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-120	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-121	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-121	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-122	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-122	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-123	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-123	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-124	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-124	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-125	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-125	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-126	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-126	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-127	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-127	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-128	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-128	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-129	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-129	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-130	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-130	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-131	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-131	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-132	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y

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** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFG/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
8	AP-WT-ZS-132	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-133	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-134	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-135	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-135	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-136	3-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-136	3-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-137	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-137	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1						3		Y
8	AP-WT-V-138	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)			ESW-521-P10, sh1		LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-V-139	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)					LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-V-140	2-WAY VALVE	241-AP	SS (HNF-SD-WM-SAR-067 REV 1-F)					LIMIT MISROUTING OF WASTE	PC2	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	1		Y
8	AP-WT-ZS-138	2-WAY VALVE POSITION SWITCHES	241-AP	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P10, sh1		NO SAFETY FUNCTION	PC1	ASME/B16.34/19 98	450 psig / CS		400°F	2 E 7 RADS (TID)	3		Y
[redacted]																		
22	AW-RW-BFP-102	REDUCED PRESSURE BACKFLOW PREVENTOR	241-AW	GS			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC3					NONE	1		Y
22	AW-RW-TI-101	POTABLE WATER TEMPERATURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-HTR-01	ELECTRIC HEATER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		90 BHP, 150 DEG. 60 GPM			NONE	3		Y
22	AW-RW-HTR-02	ELECTRIC HEATER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		90 BHP, 150 DEG. 60 GPM			NONE	3		Y
22	AW-RW-PCV-204	HEATER PRESSURE CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-MX-01	STATIC IN-LINE MIXER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FE-201	DILUENT AND FLUSH SYSTEM RAW WATER FLOW ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FIT-201	DILUENT AND FLUSH SYSTEM RAW WATER FLOW INDICATING TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-ZS-222	DILUENT AND FLUSH SYSTEM RAW WATER FLOW VALVE LIMIT SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FC-209	METERING PUMP FLOW CONTROLLER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FC-210	METERING PUMP FLOW CONTROLLER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-P-03	METERING PUMP	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		10 Hp, 0-70 GPM			NONE	3		Y
22	AW521-CHEMB-P-04	METERING PUMP		GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		10 Hp, 0-70 GPM			NONE	3		Y
22	AW521-CHEMB-PCV-212	METERING PUMP P-03 OUTLET PRESSURE CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y

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PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	AW521-CHEMB-PCV-211	METERING PUMP P-04 OUTLET PRESSURE CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-VFD-03	METERING PUMP #1 VARIABLE SPEED DRIVE		GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-VFD-04	METERING PUMP #2 VARIABLE SPEED DRIVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-LSH-213	DILUENT AND FLUSH SUMP LEVEL SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-LE-213	DILUENT AND FLUSH SUMP LEVEL ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-P-05	DILUENT/FLUSH TANK AGITATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		50 GPM, 1/2 Hp			NONE	3		Y
22	AW521-CHEMB-PI-207	RECIRCULATION PUMP DISCHARGE PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-HS-214	DILUENT/FLUSH TANK RECIRCULATION PUMP ON/OFF SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-LSLL-215	DILUENT/FLUSH TANK LEVEL SWITCH LOW LOW	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-CE-216	DILUENT/FLUSH TANK CONDUCTIVITY ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-CIT-216	DILUENT/FLUSH TANK CONDUCTIVITY INDICATING TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-TE-217	DILUENT/FLUSH TANK TEMPERATURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-TIT-217	DILUENT FLUSH TANK TEMPERATURE INDICATING TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-TK-001	DILUENT/FLUSH TANK	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		10,000 Gallons Design			NONE	3		Y
22	AW521-CHEMB-MOV-101	RAW WATER AND DILUENT/FLUSH TANK 3-WAY VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-ZS-218	RAW WATER AND DILUENT/FLUSH TANK 3-WAY VALVE LIMIT SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-LE-219	DILUENT/FLUSH TANK LEVEL ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-LIT-219	DILUENT/FLUSH TANK LEVEL INDICATING TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-LSHH-220	DILUENT/FLUSH TANK LEVEL SWITCH HIGH HIGH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-TC-221	DILUENT/FLUSH TANK HEATER TEMPERATURE CONTROLLER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-HTR-01	DILUENT/FLUSH TANK HEATER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-MOV-102	DILUENT/FLUSH TANK OUTLET ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-ZS-221	DILUENT/FLUSH TANK ISOLATION VALVE POSITION SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-PI-223	RAW WATER AND CAUSTIC/DILUENT PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-P-01	DILUENT/FLUSH PUMP #1	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		480V-60 Hp			NONE	3		Y
22	AW521-CHEMB-P-02	DILUENT/FLUSH PUMP #2	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1		480V-60 Hp			NONE	3		Y
22	AW521-CHEMB-VFD-01	DILUENT/FLUSH PUMP #1 VARIABLE SPEED DRIVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-VFD-02	DILUENT/FLUSH PUMP #2 VARIABLE SPEED DRIVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y

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* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	AW521-CHEMB-PI-225	DILUENT/FLUSH PUMP #1 OUTLET PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-PI-224	DILUENT/FLUSH PUMP #2 OUTLET PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-PIT-226	DILUENT/FLUSH PUMP OUTLET PRESSURE INDICATING TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-TT-227	DILUENT/FLUSH PUMP OUTLET TEMPERATURE TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-TE-227	DILUENT/FLUSH PUMP OUTLET TEMPERATURE ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FE-202	DILUENT/FLUSH PUMP OUTLET FLOW ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FIT-202	DILUENT/FLUSH PUMP OUTLET FLOW INDICATING TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FQI-202	DILUENT/FLUSH PUMP OUTLET FLOW INDICATING TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FY-202	DILUENT/FLUSH PUMP OUTLET REVERSE FLOW SIGNAL	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-FV-202	DILUENT/FLUSH FLOW VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-ZS-202	DILUENT/FLUSH FLOW VALVE POSITION SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-ZT-202	DILUENT/FLUSH FLOW VALVE POSITION TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-V-002A	DILUENT/FLUSH SYSTEM CHECK VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-V-002B	DILUENT/FLUSH SYSTEM CHECK VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-MOV-103	DILUENT/FLUSH ISOLATION VALVE (FAIL CLOSE)	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-ZS-103	DILUENT/FLUSH ISOLATION VALVE POSITION SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-MOV-104	DILUENT/FLUSH ISOLATION VALVE (FAIL CLOSE)	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW521-CHEMB-ZS-104	DILUENT/FLUSH ISOLATION VALVE POSITION SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-171	RAW WATER MANUAL ISOLATION VALVE OFF 14" DISTRIBUTION HEADER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-172	RAW WATER MANUAL ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-173	PRESSURE INDICATOR ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PI-104	RAW WATER PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-STR-101	RAW WATER STRAINER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-M-108	STRAINER MOTOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PDISH-103	RAW WATER STRAINER PRESSURE DIFFERENTIAL INDICATING SWITCH HIGH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-175	WATER STRAINER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-177	WATER STRAINER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-176	RAW WATER STRAINER PRESSURE DIFFERENTIAL SWITCH EQUALIZING VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y

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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	AW-RW-PCV-101	STRAINER OUTLET PRESSURE CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-174	STRAINER DRAIN MANUAL ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-MOV-107	STRAINER DRAIN MOTOR OPERATED VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-ZS-107	POSITION SWITCH FOR STRAINER DRAIN MOV	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PIT-105	RAW WATER PRESSURE INDICATION TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-178	RAW WATER PIT MANUAL ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PRV-102	RAW WATER PRESSURE RELIEF VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-RE-126	RAW WATER RADIATION ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-RT-126	RAW WATER RADIATION TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-RIAS-126	RAW WATER RADIATION INDICATING ALARM SWITCH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FQI-101	FLOW TOTALIZER FOR RAW WATER TO DILUENT AND FLUSH SYSTEM	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FE-101	FLOW ELEMENT FOR RAW WATER TO DILUENT AND FLUSH SYSTEM	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-SW-V-207	SANITARY WATER MANUAL ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-POT-V-101	POTABLE WATER MANUAL ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-POT-V-111	POTABLE WATER HEATER MANUAL ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-POT-HTR-101	POTABLE WATER HEATER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-POT-PRV-101	POTABLE WATER HEATER PRESSURE RELIEF VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-POT-V-112	POTABLE WATER HEATER DRAIN VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-179	MANUAL ISOLATION VALVE TO FILTERED WATER SYSTEM	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-181	MANUAL ISOLATION VALVE TO FILTERS	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-182	75 MICRON FILTER BYPASS VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FLT-102	75 MICRON FILTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-183	75 MICRON FILTER INLET ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-184	75 MICRON FILTER OUTLET ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-185	FILTER OUTLET CHECK VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PDISH-112	75 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH HIGH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-186	75 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-187	75 MICRON FILTER PRESSURE DIFFERENTIAL SWITCH HIGH EQUALIZING VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y

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1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3 DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	AW-RW-V-188	75 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-192	THREE WAY VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PI-108	FILTERED WATER PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-193	FILTERED WATER PRESSURE INDICATOR MANUAL ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-TK-101	FILTERED WATER STORAGE TANK	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-190	FILTERED WATER STORAGE TANK ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-191	FILTERED WATER STORAGE TANK AIR CHANGE VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-206	FILTERED WATER STORAGE TANK DRAIN VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FE-113	FILTERED WATER FLOW ELEMENT	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FT-113	FILTERED WATER FLOW TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-202	MIXER PUMP SPARGE RING ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FLT-103	5 MICRON FILTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-194	5 MICRON FILTERED WATER INLET ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-195	5 MICRON FILTERED WATER OUTLET ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FLT-104	5 MICRON FILTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-196	5 MICRON FILTERED WATER INLET ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-197	5 MICRON FILTERED WATER OUTLET ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PDISH-114	5 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH HIGH	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-198	5 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-200	5 MICRON FILTER PRESSURE DIFFERENTIAL INDICATING SWITCH ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-199	5 MICRON FILTER PRESSURE DIFFERENTIAL SWITCH EQUALIZING VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-201	MANUAL ISOLATION VALVE FOR MIXER PUMP COLUMN FILL	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-204	PRESSURE CONTROL VALVE PCV-102 ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PI-107	PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PCV-102	PRESSURE CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PI-106	PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-203	PRESSURE CONTROL VALVE PCV-102 ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-205	PRESSURE CONTROL VALVE PCV-103 ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y

TBR = TO BE REVIEWED
* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
** = SEISMIC ANCHORING REQUIRED
1. UBC, ZONE 2B, STANDARD OCCUPANCY
2. UBC, ZONE 2B, ESSENTIAL FACILITY
3. DOE-STD-1020

PROJECT W-521 MASTER EQUIPMENT LIST

SYS NO	EQUIPMENT IDENTIFICATION NUMBER	COMPONENT DESCRIPTION/FUNCTION	LOCATION	SAFETY CATEGORY DESIGNATION (REF/DOC)	VI SUPP.	MFC/MODEL	P & ID/DWG	MAINTENANCE OR CALIBRATION PROCEDURE/ DATA SHEET	SAFETY FUNCTION	NPH & PERFORMANCE CATEGORY	CODES & STANDARDS	DESIGN PARAMETERS PRESS, VOLTS, MAT. CAT., ETC	SEISMIC CATEG.(SEE NOTES)	DESIGN 1 CONDITIONS (TEMP/DUST)	RADIOLOGICAL CONDITIONS	QUALITY LEVEL	USER-DEFINED (NOTES/ COMMENTS)	CRITICAL FOR FIRST XFER
22	AW-RW-PI-109	PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PCV-103	PRESSURE CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PI-110	PRESSURE INDICATOR	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-V-206	PRESSURE CONTROL VALVE PCV-103 ISOLATION VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-PRV-102	PRESSURE RELIEF VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FQI-115	FLOW TOTALIZER FOR MIXER PUMP COLUMN FILL	241-AW	GS			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-RW-FQI-116	FLOW TOTALIZER FOR MIXER PUMP SPARGE RING	241-AW	GS			ESW-521-P-7, sh1		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-521-CHEMB-RE-228	RADIATION ELEMENT	241-AW	GS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-7, sh 2		DETECT AND ALARM RADIATION	PC1					NONE	3		Y
22	AW-521-CHEMB-RSH-228	RADIATION SWITCH HIGH	241-AW	GS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-7, sh 2		DETECT AND ALARM RADIATION	PC1					NONE	3		Y
22	AW-521-CHEMB-RAH-228	RADIATION ALARM HIGH	241-AW	GS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-7, sh 2		DETECT AND ALARM RADIATION	PC1					NONE	3		Y
22	AW-521-CHEMB-RE-229	RADIATION ELEMENT	241-AW	GS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-7, sh 2		DETECT AND ALARM RADIATION	PC1					NONE	3		Y
22	AW-521-CHEMB-RSH-229	RADIATION SWITCH HIGH	241-AW	GS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-7, sh 2		DETECT AND ALARM RADIATION	PC1					NONE	3		Y
22	AW-521-CHEMB-RAH-229	RADIATION ALARM HIGH	241-AW	GS (HNF-SD-WM-SAR-067 REV. 1F)			ESW-521-P-7, sh 2		DETECT AND ALARM RADIATION	PC1					NONE	3		Y
22	AW-521-CHEMB-FQ1-230	DILUENT & FLUSH FLOW TOTALIZER	241-AW	GS			ESW-521-P-7, sh 2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-521-CHEMB- FV-201	DILUENT & FLUSH WATER FLOW CONTROL VALVE	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh 2		NO SAFETY FUNCTION	PC1					NONE	3		Y
22	AW-521-CHEMB-ZT201	DILUENT & FLUSH WATER VALVE POSITION TRANSMITTER	241-AW	GS (LTR CHG-0000281, SUPPORTS GS EQUIPMENT)			ESW-521-P-7, sh 2		NO SAFETY FUNCTION	PC1					NONE	3		Y

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* = TO AVOID FUTURE COSTLY MISTAKES, PURCHASE CGI, THEN INSTALL GS.
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Attachment T

Attachment T

Deviations from the Double-Shell Tank Subsystem Specifications

DEVIATIONS FROM THE DST SUBSYSTEM SPECIFICATIONS

SPECIFICATION	ITEM	SECTION	REQUIREMENT	RECOMMENDATION / BASIS	TASK/ TASK#
HNF-4157	1	3.3.1.2.a	Indoor electrical equipment enclosures shall be NEMA Type 12.	Design to appropriate NEMA type. *Basis*: Electrical enclosures and junction boxes of the proper National Electrical Manufacturers Association (NEMA) rating shall be utilized to protect internal components where appropriate (good engineering practices).	No
	2	3.3.1.2.h	Outdoor electrical equipment enclosures shall be NEMA Type 4 or Type 4x.	Design to appropriate NEMA type. *Basis*: Electrical enclosures and junction boxes of the proper National Electrical Manufacturers Association (NEMA) rating shall be utilized to protect internal components where appropriate (good engineering practices).	No
	3	3.3.1.3.h	All piping shall be designed, constructed, installed, and tested per ASME B31.3.	Design to the appropriate ASME. *Basis*: ASME B31.3 would not be appropriate for all piping with respect to cost versus benefit.	No
HNF-4160	1	3.3.1.g	Electrical equipment enclosures shall be as a minimum NEMA Type 4, per NEMA ICS 6.	Design to appropriate NEMA type. *Basis*: Electrical enclosures and junction boxes of the proper National Electrical Manufacturers Association (NEMA) rating shall be utilized to protect internal components where appropriate (good engineering practices).	No
	2	3.2.1.4.c	The threshold design pressure of new DST Transfer Valving Subsystem components shall be 4580 kPa.	Design to 3103 kPa. *Basis*: Data from the RPP DA given to W-521.	No
	3	3.2.2.a	Transfer valve manifolds and jumpers should be 7.6 cm internal diameter.	Design to prescribed diameter except where limited by existing pit design. *Basis:* Requirement not appropriate for cases where diameter is limited by existing pit design.	No
HNF-4161	1	3.2.1.1.a	The primary confinement piping shall confine waste at a design pressure of 4580 kPa.	Design to 3103 kPa. *Basis*: Data from the RPP DA given to W-521.	No
	2	3.2.1.4.a	The primary confinement piping shall confine the diluent/flush water at the design pressure defined in Section 3.2.1.1.a.	Design to 3103 kPa. *Basis*: Data from the RPP DA given to W-521.	No

SPECIFICATION	ITEM	SECTION	REQUIREMENT	RECOMMENDATION / BASIS	TASK/ TASK#
HNF-4162	1	3.2.5.2.4.a	The in-tank temperature range for transfer pump design is 10 to 104°C (50 to 220°F).	Design to appropriate temperature. *Basis:* Specification requirement is incorrect and will be modified.	No
HNF-4163	1	3.2.1.1.d	The DST Diluent and Flush Subsystem shall have the capability to be used for in-line dilution at a flow rate as high as 0.175m3/min (46 gal/min) for periods up to 5 days.	Design to 53 gal/min. *Basis*: Data from the RPP DA given to W-521.	No
	2	3.3.1.d	Electrical equipment enclosures shall be, as a minimum NEMA Type 4 or 4X, per industrial controls and systems, NEMA ICS 6. Electrical enclosures shall have the cover secured by a toggle-actuated handle to minimize difficulties in opening and fully securing the enclosure.	Design to appropriate NEMA type. *Basis*: Electrical enclosures and junction boxes of the proper National Electrical Manufacturers Association (NEMA) rating shall be utilized to protect internal components where appropriate (good engineering practices).	No
	3	3.2.1.1.c	The DST Diluent and Flush Subsystem shall have the capacity to provide solutions to be used for waste transfer line preheating, in-line dilution, in-tank dilution, and tank-heel flushing at temperatures as high as 40 degrees C.	Design to temperatures identified in Table 3-1 of SDD-01. *Basis:* Data from the RPP DA given to W-521.	No
	4	3.2.1.1.b	The DST Diluent and Flush Subsystem shall have the capacity to provide heated water or solution at a flow rate of 140 gal/min at up to 4,480 Kpa	Design to parameters in Table 3-1 of SDD-01. *Basis:* Data from the RPP DA given to W-521.	No
	5	3.2.1.2.d	The DST Diluent and Flush Subsystem shall be capable of providing a flow of 160 gal/min at a pressure of 4,480 Kpa to the DST Transfer Valving Subsystem for flushing waste transfer lines.	Design to parameters in Table 3-1 of SDD-01. *Basis:* Data from the RPP DA given to W-521.	No
	6	3.3.1.r	The diluent/flush supply piping to the valve and pump pits shall have a design pressure rating of at least 4,480 kPa.	Design to parameters in Table 3-1 of SDD-01. *Basis:* Data from the RPP DA given to W-521.	No
	7	4.1.2.a	Seat closure tests shall be performed for diluent and flush valves in accordance with the ASME B16.34 and *Pressure Testing of Steel Valves*, MSS-SP-61. Seat leakage from each flow side of the isolated port shall be within the limits specified in MSS-SP-61.	Design to ASME B16.34 and API-598. *Basis:* Good engineering practices.	

SPECIFICATION	ITEM	SECTION	REQUIREMENT	RECOMMENDATION / BASIS	TASK/ TASK#
HNF-4164	1	3.2.5.2.5.	The in-tank temperature range for mixer pump design is 10 to 104°C (50 to 220°F).	Design to appropriate temperature. *Basis:* Specification requirement is incorrect and will be modified.	No
	2	3.3.1.i	The DST Transfer Pump Subsystem's net positive suction head (NPSH) required shall be less then the NPSH available.	Design to appropriate NPSH. *Basis*: Fundamentals of physics and pump technology make it clear that these requirement extremes can not exist at the same time.	Yes/ Subtask #7
	3	3.3.1.f	Electrical equipment enclosures shall be industrial controls and systems NEMA ICS 6 Standards.	Design to appropriate NEMA type. *Basis*: Electrical enclosures and junction boxes of the proper National Electrical Manufacturers Association (NEMA) rating shall be utilized to protect internal components where appropriate (good engineering practices).	No

Attachment U

Attachment U

Revised SDDs

PROJECT W-521, DESIGN GUIDE - MODIFICATIONS TO 241-AY AND 241-AZ VENTILATION SYSTEMS

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract 4412, Release 46
Report No. 990920203-024
Revision 1

September 2000

prepared by

HND Team

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Prepared by: Scott Pierce, P.E.

Approved by: RLFritz
Bob Fritz

Date: 9-29-00

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1.0 INTRODUCTION

The existing 241-AY and 241-AZ ventilation systems will be modified to support Phase 1 WFD. These modifications will affect both the primary and annulus ventilation systems. In the case of the primary tank ventilation system, a number of upgrades will improve the existing system's code compliance and operability. In the case of the annulus ventilation systems, the modifications will increase the airflow rate through air slots in the primary tank foundations.

The 241-AY and 241-AZ primary tanks are ventilated by the 241-AZ-702 system. Presently, the system's design does not comply with some codes and standards. Project W-521 will modify the system to improve the system's operability and to correct several of these noncompliances. Specifically, Project W-521 will perform the following activities:

- Install additional components to provide redundancy of all major equipment. These components include a second High Efficiency Moisture Eliminator (HEME) and condenser. Additional ducting and instrumentation will be installed to support these units.
- Construct an additional cell to house the new HEME and condenser.
- Install a cooling system for the new condenser. This will consist of a new chiller, storage tank, expansion tank, and pumping system.
- Eliminate Catch Tank AZ-151 as a discharge point for the system's condensate. This requires installing a pump in the 241-AZ-702 seal pot so condensate may be pumped to any of the 241-AY or 241-AZ tanks.
- Provide a redundant drain path for condensate leaving the system.
- Install new drain lines that route condensate from the existing filtration units to the seal pot.
- Replace the existing primary exhaust fans with new units that provide stable operation.
- Replace the sample probe of the stack's radiation monitoring system with a new shrouded probe.

Separate systems ventilate the annulus space of the 241-AY and 241-AZ tanks. These systems provide airflow through the annular space between the primary and annulus tank sidewalls. The systems also provide airflow through slots in the foundation of the primary tanks. Currently, the systems do not provide sufficient airflow through the latter to meet the requirements of HNF-5196, Revision 0. These systems will be modified to provide a nominal airflow of 1000 CFM (and a minimum of 850 CFM) through the air slots. To achieve this flow rate, Project W-521 will perform the following:

- Install supply fans to increase each system's overall air flow.
- Install a control system to achieve the required flow while limiting the annulus vacuum.
- Refurbish several components that are no longer functional.

2.0 BASIS FOR REDESIGN

2.1 Basis for modifying the 241-AZ-702 System

Project W-521 will redesign portions of the existing 241-AZ-702 System. The following describes the bases for these modifications.

- The design of the existing system included only one HEME and condenser. The NOC requires operating both units when ventilating the tanks. When servicing either, the units must be bypassed and elevated emissions are released from the system's exhaust stack. To eliminate this problem, a second HEME and condenser will be installed. Installing these two components will greatly increase the system's redundancy.

- Space is limited within the existing cell. To add a new HEME and condenser, a new cell must be constructed. The new cell will be located next to and share the south wall of the existing cell.

- The new condenser must be connected to a cooling system. Although the existing condenser's cooling system could be utilized, adding a new cooling system provides redundancy to the system's overall design. The new chiller and pumping system will be located next to the new cell.

- Condensate from the ventilation system currently drains to the Catch Tank 241-AZ-151. This catch tank is a single walled vault that does not meet current codes and standards for storing radioactive liquids. Redirecting the condensate to the 241-AY and 241-AZ tanks will allow the catch tank to be removed from service. The tank will be isolated with lines capped and abandoned in place. The elevation difference between the system and the tanks is insufficient to gravity drain the condensate to all of the 241-AY and 241-AZ tanks. Therefore, a new seal pot will be installed in the 241-AZ-702 system that includes a pump. This pump will allow condensate to be sent to any of the 241-AY and 241-AZ tanks.

- With the existing design, condensate leaves the system and flows through a single line. If the line becomes damaged or plugged, condensate will back up into the system and cause operational problems. If the system floods with condensate, the operational problems could cause the system to be shut down. Providing a redundant discharge line will greatly reduce the likelihood of this scenario.

- The existing system employs filtration trains that contain HEPA and HEGA filters. Each train has two drains to collect liquid that may accumulate in the trains. Presently, the drains lead to sight glasses that must be emptied manually using portable containers. Due to radiological concerns for the operators and the difficulty in disposing of radioactive liquids, the existing drains and sight glasses will be piped directly into the system's condensate collection system.

- The primary exhaust fans currently operate at an unstable point on their performance curves at low flow rates. Replacing the fans with a different model will improve the operability and maintainability of the fans.

- The sample probe of the stack's radiation monitoring system will be replaced and new piping will be routed from the probe to the analyzer. This modification will bring the stack's radiation monitoring system into compliance with ANSI/HPS N13.1. Furthermore, a flanged port will be added near the sample probe's location. This connection will allow access for future sampling activities.

These changes will improve the system's operability. The modifications also make the system compliant with existing codes and standards.

2.2 Basis for modifying the 241-AY and 241-AZ Annulus Ventilation Systems

Project W-521 will redesign portions of the annulus ventilation systems. HNF-5196, Revision 0 requires a minimum airflow through the annulus air slots of 850 CFM. This flow rate is necessary to achieve sufficient cooling of the tanks during mixer pump operations. HNF-5196, Revision 0 also limits the difference in pressure between the primary tank and annulus to 6 inches (w.g.). Adding a supply fans to the annulus ventilation systems will increase the airflow through the air slots. Installing a control system that modulates the fan speeds will allow control of the annulus pressure relative to the primary tank pressure.

To return the 241-AZ annulus ventilation system to active service, some existing components must be replaced or refurbished. The existing inlet filter plenum is plugged to the point that it is unusable. The integrity of the tank balancing valves is questionable. The exhaust filter plenum cannot be tested to the requirements of ASM N510. Finally, the annulus leak detection CAMs are in need to repairs. These issues should be corrected as part of the system modifications to achieve higher flow rates.

3.0 DESIGN REQUIREMENTS

The following defines the specific codes, standards and requirements that the modifications must meet.

3.1 HEME and Condenser Modification

A second HEME and condenser shall be installed. The new units shall be installed in parallel with the existing units. Valves to isolate the two units shall have handles that extend through the cell wall to the building's exterior. The units shall be equipped with instrumentation consistent with the existing instrumentation and shall connect to the existing Monitoring and Control System. Access shall be provided through the cell's roof above both components. The opening shall be the same size as the openings above the existing units.

A new vent cell will be constructed to contain the new HEME and condenser. The new cell shall be ventilated and maintained at a vacuum consistent with the existing system. The new cell shall include a sump and provisions to empty the sump. Access to the new cell shall include hatches above major equipment. The design and construction of concrete shall meet ACI 318 (refer to HNF-5196, Rev. 0, Section 3.3.1.1.b).

The new chiller and pumping system shall be designed to provide the same amount of cooling as the existing chiller and pumping system.

3.2 System Drain Modifications

A new seal pot shall be installed that allows condensate to be periodically pumped to the any of the 241-AY or 241-AZ tanks. The fluid level in the new seal pot shall be maintained at the same level at the existing seal pot. The new seal pot shall be ventilated. The drain path leading from the seal pot shall be redundant.

All new piping shall be fabricated from 300 series stainless steel material and shall be of all welded construction. The new piping shall be designed, fabricated, and inspected per ASME B31.3 (refer to HNF-5196, Rev. 0, Section 3.3.1.2). Condensate draining from the system shall be doubly contained.

3.3 Filtration Unit Drains

Each plenum of the existing filtration trains shall be equipped with a drain. The drains shall be routed to the new seal pot located in the cell. The new drain lines shall be designed, fabricated, and inspected per ASME B31.3. The new piping shall be fabricated from 300 series stainless steel material and shall be of all welded construction (refer to HNF-5196, Rev. 0, Section 3.3.1.2). The new drain lines shall meet the requirements of ASME N509 (refer to HNF-5196, Rev. 0, Section 3.3.1.1.a).

3.4 Fan Modification

The primary exhaust fans (AZ-K1-5-1A and AZ-K1-5-1B) shall be replaced. The new fans shall possess an operating curve that allows for stable operation throughout the system's operating range. The fan shall include a shaft seal to limit in-leakage at the shaft (refer to HNF-5196, Rev. 0, Section 3.3.1.4.e). The replacement fan shall be designed in accordance with AMCA 99-0200 (Classification for Spark Resistant Construction), Type B requirements (refer to HNF-5196, Rev. 0, Section 3.3.1.4.a). The fan shall be certified as meeting the requirements of AMCA 210 for exhaust fan performance (refer to HNF-5196, Rev. 0, Section 3.3.1.b). The fan also shall meet the requirements of ASME N509, ASME N510 and ASME AG-1 (refer to HNF-5196, Rev. 0, Section 3.3.1.4.a). The installed configuration shall include gravity dampers that prevent back draft through the fan (refer to HNF-5196, Rev. 0, Section 3.3.1.4.c).

3.5 Stack Monitoring Modification

The sample probe for the stack monitoring system shall be replaced. Piping that connects the probe to the analyzer also shall be replaced. The new probe and piping shall comply with ANSI/HPS N13.1 (refer to HNF-5196, Rev. 0, Section 3.2.1.1.3).

3.6 Annulus Ventilation Modifications

The annulus ventilation systems for the 241-AY and 241-AZ tanks shall be redesigned to provide a nominal airflow of 1000 CFM (and a minimum flow of 850 CFM) to the air slots of each tank. The redesigned system shall limit the pressure difference between the primary and annulus pressure to 6 inches (w.g.) (refer to HNF-5196, Rev. 0, Section 3.2.1.1.1.b). Instrumentation shall monitor the annulus pressure within a range of at least +10 inches (w.g.) to –20 inches (w.g.) (refer to HNF-5196, Rev. 0, Section 3.2.1.2.2.a).

The inlet filters and exhaust filters shall be constructed of 300 series stainless steel (refer to HNF-5196, Rev. 0, Section 3.3.1.3.b). The exhaust units shall be a "bag-out" design (refer to HNF-5196, Rev. 0, Section 3.5.1.f). The units shall be designed to allow testing to ASME N510 (refer to HNF-5196, Rev. 0, Section 3.2.4.b, 3.5.1.e, and 4.1.2.a). The inlet filter plenums shall contain provisions to prevent intrusion by animals or large debris (refer to HNF-5196, Rev. 0, Section 3.3.1.3.f). Butterfly valves shall be installed to allow isolating the annulus space from the annulus ventilation system (refer to HNF-5196, Rev. 0, Section 3.3.1.5.a). The valve shall meet the requirements of ASME N509 and ASME AG-1 (refer to HNF-5196, Rev. 0, Section 3.3.1.5.c and 3.3.1.5.d).

3.7 General Requirements for all Modifications

The new components shall have a design life of 35 years (refer to HNF-5196, Rev. 0, Section 3.2.3.a). System modifications and replacement components shall meet the applicable criteria of the following:

- WHC-SD-GN-ER-501, "Natural Phenomena Hazards, Hanford Site Washington" (refer to HNF-5196, Rev. 0, Section 3.2.5.1.a and 3.2.5.2.3.b)
- UCRL 15673, "Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities" (refer to HNF-5196, Rev. 0, Section 3.2.4.a)
- DOE 6430.1A, Section 0110-3, "Flexibility" (refer to HNF-5196, Rev. 0, Section 3.2.7.a)
- DOE 6430.1A, Section 1300-7, "Confinement Systems" (refer to HNF-5196, Rev. 0, Section 3.3)
- DOE 6430.1A, Section 1300-11, "Decontamination and Decommissioning" (refer to HNF-5196, Rev. 0, Section 3.3.8.a)
- DOE 6430.1A, Section 1300.12 "Human Factors Engineering" (refer to HNF-5196, Rev. 0, Section 3.3.7.a)
- DOE 6430.1A, Section 1323, "Radioactive Liquid Waste Facilities" (refer to HNF-5196, Rev. 0, Section 3.3)

System modifications and replacement components shall incorporate occupational safety and health design features that comply with the requirements of WHC-SD-WM-HSP-002 (refer to HNF-5196, Rev.0, Section 3.3.6.1.a).

3.8 Safety Classification of Components

Replacement components shall be designed in accordance with safety classifications. Safety classifications of existing components are described in HNF-SD-WM-SAR-067, Addendum 3. A preliminary listing of safety classifications is provided in Tables 3-1 and 3-2. These classifications are provided for purposes of the conceptual design. Actual safety classifications shall be determined during definitive design using the process described in HNF-PRO-700, HNF-PRO-702, HNF-PRO-703, and HNF-PRO-704.

Table 3-1. Preliminary Safety Classification of New Primary Components.

New Component	Safety Function	Safety Classification
Condenser	Provides primary containment of radioactive gases and liquids. Provides an environmental function of abating stack emissions.	GS
HEME	Provides primary containment of radioactive gases and liquids. Provides an environmental function of abating stack emissions.	GS
Condenser and HEME piping	Provides primary containment of radioactive gases and liquids.	GS
Chiller and Pumps	Does not provide a safety function. Supports the environmental function of abating of stack emissions.	GS
Cell Annex	Provides secondary containment of radioactive liquids, as well as shielding of high radiation components.	GS (1)
Drain lines from filtration units.	Provides primary containment of radioactive condensate.	GS
Seal Pot	Provides a drain path for condensate leaving the system. Failure of the drain path will lead to shut down of ventilation system due to a backup of condensate. Loss of ventilation leads to the potential for a deflagration accident. The seal pot also provides primary containment of radioactive condensate.	SC
Seal Pot Pump	Provides ability to pump to tanks other than AZ-102 (not a safety function). Provides double containment of condensate.	GS
Gravity Drain from Seal Pot to AZ-101	Provides a dedicated drain path for condensate leaving the system (independent of operating the Seal Pot Pump). Failure of the drain path will lead to shut down of ventilation system due to a backup of condensate. Loss of ventilation leads to the potential for a deflagration accident. The line also provides primary and secondary containment of radioactive condensate.	SC
Forced Drain from Seal Pot to AY-101, AY-102 and AZ-101	Provides ability to pump to tanks other than AZ-102 (not a safety function). Provides double containment of condensate.	GS
Primary Exhaust Fans	Provides motive force for ventilating the primary tank headspace. Loss of ventilation leads to the potential for a deflagration accident.	SC
Stack Radioactive Monitoring System	Provides monitoring for releases of radioactive material. The Continuous Air Monitor Interlock relies on this monitoring to mitigate the consequences of a spray leak accident.	SC

Notes (1): The cell annex has a preliminary classification of General Service due to its containment function. However, the cell contains Safety Class equipment. Failure of the cell's roof or walls could lead to failure of the drain lines leading from the HEME and condenser. This "three-over-one" situation will be analyzed during definitive design to assure that the drain lines still meet their Safety Class function.

Table 3-2. Preliminary Safety Classification of New Annulus Components.

New Component	Safety Function	Safety Classification
Supply Piping	Provides a flow path into the tank. Loss of the flow path would prevent operation of the leak detection CAMs. If the leak detection CAMs are inoperable, a leak into the annulus tank may go undetected. A leak into the annulus tank leads to the potential for a deflagration accident.	SC
Supply Filters	No safety function. Provides some filtration of the air entering the annulus.	GS
Supply Fan & VFD	Provides ability to obtain minimum flow through annulus slots. Loss of flow would lead to a loss of tank cooling. Loss of cooling leads to the potential for a tank bump accident.	SS
Exhaust Piping	Provides a flow path into the tank. Loss of the flow path would prevent operation of the leak detection CAMs. If the leak detection CAMs are inoperable, a leak into the annulus tank may go undetected. A leak into the annulus tank leads to the potential for a deflagration accident.	SC
Exhaust Filters	No safety function. Provides filtration of the air leaving the annulus tank.	GS
Exhaust Fan & VFD	Provides flow past the leak detection CAMs. Loss of flow would lead to inability to detect a leak of the primary tank into the annulus tank. A leak into the annulus tank leads to the potential for a deflagration accident.	SC
Leak Detection CAMS	Provides ability to monitor for a primary tank leaking into the annulus tank. A leak into the annulus tank leads to the potential for a deflagration accident.	SC
Flow Instrumentation	Monitors flow rate of air through the annulus slots. Loss of flow would lead to a loss of tank cooling. Loss of cooling leads to the potential for a tank bump accident.	SS
Control Equipment	Provide automatic control of fan speed. However, the fan speeds can be manually controlled.	GS

DILUENT AND FLUSH
SYSTEM DESIGN DESCRIPTION

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412/Task 00008
Report No. W521-SDD-01
Revision 2

September 2000

Prepared by: Tom Salzano, P.E.
Danny Mendoza

Approved by: RLFritz
Robert L. Fritz

Date: 9-30-00

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Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AC	Administrative Controls
ACD	Advanced Conceptual Design
ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
DOE	U.S. Department of Energy
DST	Double-Shell Tank
FSAR	Final Safety Analysis Report
HLW	High-Level Waste
HMI	Human Machine Interface
HNF	Hanford Nuclear Facility
ICE	Instrument Control and Electrical
LAW	Low Activity Waste
O&M	Operations and Maintenance
PUREX	Plutonium-Uranium Extraction
RPP	River Protection Project
RCS	Retrieval Control System
SC	Safety Class
SDD	System Design Description
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To be determined
TBR	to be refined
TSR	Technical Safety Requirements
TWRS	Tank Waste Remediation System
UL	Underwriters Laboratories
UPC	Uniform Plumbing Code
USQ	Unresolved Safety Question
WFD	Waste Feed Delivery
WFDS	Waste Feed Delivery System
WTF	Waste Treatment Facility

1.0 INTRODUCTION

This System Design Description (SDD) identifies performance requirements, defines bases and provides references to requisite codes and standards for the definitive design of Waste Feed Delivery System (WFDS) Project W-521 Diluent and Flush System. This revision incorporates Level 2 requirements as specified in HNF-4163, Rev. 0, *Double-Shell Tank Diluent and Flush Subsystem Specification.*

Project W-521 provides diluent and flush capabilities to all tanks within the project scope. These capabilities are provided by new systems or modifications to existing systems. Project W-521 will install a single new diluent and flush system that provides diluent for both AW and AP Farms. The distribution system installed by Project W-211 at AN Farm will be modified to supply diluent to AY Farm. The system installed by Project W-058 for the Cross-Site Transfer System will be modified to service all tanks at SY Farm. All systems in the scope of Project W-521 will be brought into compliance with the requirements contained in this SDD.

1.1 System Identification

The Diluent and Flush System will supply treated water for in-tank and in-line dilution, pipe pre-heating, and line flushing for LAW and HLW waste transfers including intra-farm transfers, inter-farm transfers, and transfers to the RPP Waste Treatment Facility (WTF). The major components of the system are:

- Heating equipment,
- Diluent and Flush structures,
- Chemical unloading equipment, and
- Diluent and Flush water transfer equipment.

1.2 Limitations

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary, or of a conceptual nature. This SDD will be a living document throughout the design phases of W-521, and will become more detailed as the design progresses through Definitive Design.

Requirements were taken from the *Double-Shell Tank Diluent and Flush Subsystem Specification HNF-4163, Rev. 0.* The previous SDD revision was based on the Draft Level 2 Specifications.

This SDD does not include requirements or system descriptions for the raw or potable water distribution system upstream of the branch point that feeds the W-521 Diluent and Flush System. The main distribution headers are under the exclusive control of site utilities.

1.3 Ownership

This SDD is owned by the Project Engineer responsible for the Diluent and Flush System.

1.4 Definitions

Administrative Lock - A locking device that prevents an inadvertent equipment start. Administrative locks ensure that the equipment or systems(s) being isolated and/or controlled cannot be operated (e.g., removing the motive force of a transfer pump [e.g., electrical power, steam, water, or air] and installing an administrative lock so that the transfer pump cannot be activated) until the administrative lock is removed.

Diluent - Water treated with sodium Hydroxide (NaOH) and/or sodium nitrite ($NaNO_2$) used to dilute waste as it is retrieved from a tank.

General Service - Structure, systems, and components (SSCs) not classified as either Safety Class or Safety Significant

Manifold - Remotely installed rigid piping system inside a pit that transfers waste and flush water between nozzles.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

  - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
  - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
  - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
  - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
  - Two Safety – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

(**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

RPP Design Authority – A person qualified in the practice of engineering with four years demonstrated job related experience including two years in their specific functional areas. For nuclear structures, systems, or components, they shall have at least one year nuclear experience. The RPP Design Authorities for the facility and for the Project must have completed the RPP Design Authority Qualification Card and have an appointment letter approved by the RPP Chief Engineer.

Safety Class (SC) SSC – An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant (SS) SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall – Denotes a requirement.

Should – Denotes a recommendation. If a "should" requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

TBD – To be determined. A study and/or calculation needs to be performed in order to provide a sufficient technical basis for the requirement.

TBR – To be refined. A "soft" basis for the requirement has been identified. However, a further study and/or calculation needs to be performed in order to solidify the requirement's technical basis.

Transfer-Associated Structure – Pump pits, valve pits, diversion boxes, or cleanout boxes.

Waste Feed – Waste slurry to be transferred to the Waste Treatment Facility (WTF) containing a mixture of solids and liquids.

2.0 GENERAL OVERVIEW

2.1 System Functions

The overall mission of the Diluent and Flush System is to reliably deliver the required quantities of treated water to the storage, treatment and immobilization systems/facilities on schedule, within specifications, and in conformance with regulatory, safety, and contractual requirements. To accomplish this mission, the Diluent and Flush System must meet the requirements of the following functions:

- Deliver diluent to transfer-associated structures,
- Deliver flush water to transfer-associated structures, and
- Monitor and control the diluent and flush system.

The safety functions of the Diluent and Flush System are as follows:

- Confine concentrated chemicals and diluent,
- Prevent exposure of the onsite worker to a chemical (principally concentrated caustic) spray release, and
- Mitigate exposure to personnel by providing radiation detection and alarm functions.

2.2 System Classifications

Most of the subsystems and components within the Diluent and Flush System are classified as "General Service". Those components that prevent or mitigate a caustic spray leak are also classified as GS. The backflow preventer(s) between the raw water system and the Diluent and Flush System are classified as safety significant.

2.3 Basic Operational Overview

The Diluent and Flush System will be used to supply treated water for in-tank and in-line dilution, pipe pre-heating, and line/pump flushing for LAW and HLW waste transfers including intra-farm transfers, inter-farm transfers, and transfers to the RPP/WTF. A simplified diagram of the systems is shown in Figure 2-1.

- Water from the Raw Water Distribution System will be routed to a water heater for heating.
- NaOH or $NaNO_2$ will be supplied via a metering pump from a tanker truck.
- The NaOH or $NaNO_2$ will be mixed to a pre-determined ratio and routed directly to the valve pits for line flushing or in-tank/in-line dilution or routed to a temperature controlled storage tank.

- The Retrieval Control System (RCS) will monitor and control chemical metering pump(s), diluent supply pump(s), water heater operation, system flow rates, temperature, tank level, and chemical concentrations.
- A leak detection system provides notification of diluent leakage from the system into a curbed concrete low point sump.

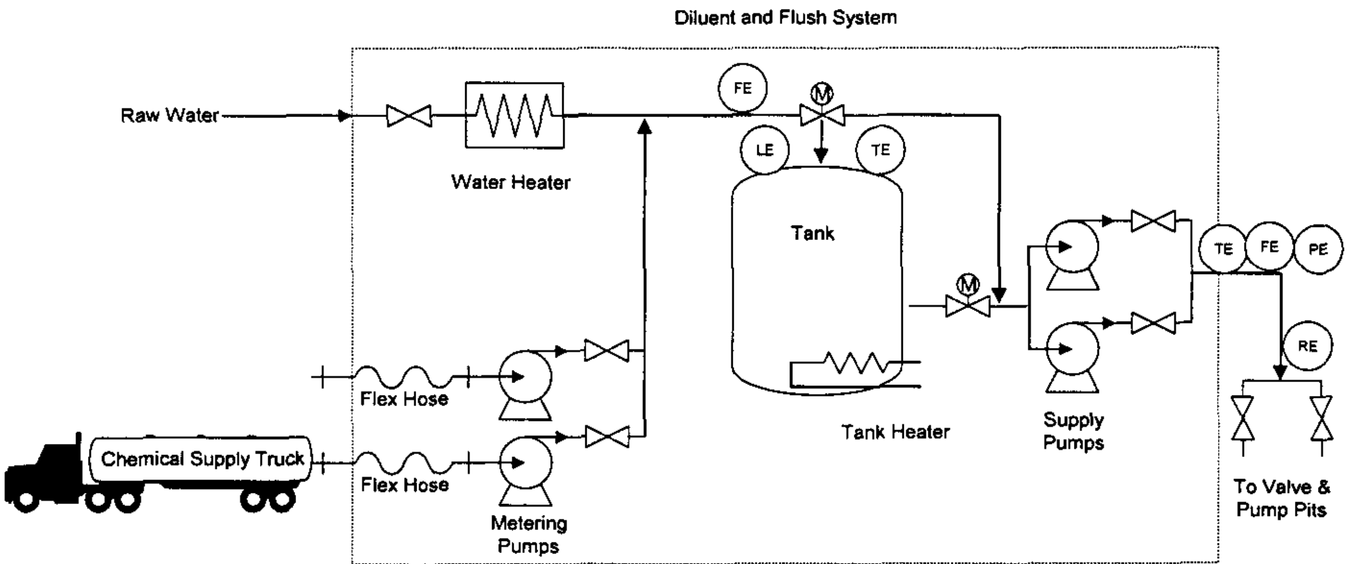

Figure 2-1. Typical Diluent and Flush System Major Components

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section identifies the general requirements for the Diluent and Flush System and the bases for these requirements.

3.1.1 System Functional Requirements

a. __Requirement:__ The Diluent and Flush System shall provide temperature-adjusted diluent at an adjustable flow rate to the transfer-associated structure to support initiation of waste transfer, dilution of waste during the transfer, and subsequent termination of the waste transfer.

__Basis:__ This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.1.

b. **Requirement:** The Diluent and Flush System shall provide temperature-adjusted and chemically adjusted water at an adjustable flow rate to the transfer-associated structure to support termination of the waste transfer and corrosion protection of the transfer route.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.2.

c. **Requirement:** The Diluent and Flush System shall monitor and control preparation and delivery of diluent and flush solutions.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.3.

3.1.2 Subsystems and Major Components

3.1.2.1 Heating Equipment

a. **Requirement:** The Diluent and Flush System shall be capable of providing water or solution per the five different flush operations specified in the following table:

Table 3-1. Diluent System Requirements.

Operation	Required Temp. (°F)	Flowrate (gpm)	Required Volume (gal)
Waste Transfer Line Preheat	165	70	Two times line volume
In-Line Dilution	155 155	53 140 for 3 min.	331,200 (5 days) 420 gal
Transfer and Line Flush	104	160	Two times line volume
In-Tank Dilution	140	140	260,000
Tank-Heel Flushing	140	140	140,000

Basis: This requirement is per direction of the project Design Authority, and is being incorporated into the W-521 technical baseline documentation.

b. **Requirement:** The Diluent and Flush System shall have the capability to provide solutions at the temperature specified in Table 3-1.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.1.c as modified per Design Authority direction.

c. **Requirement:** The Diluent and Flush System shall have the capability to control the diluent solution temperature to within ± 5°C (9°F).

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.3.c.

3.1.2.2 Diluent and Flush Structures

a. **Requirement:** The Diluent and Flush Station (containing piping, tanks, pumps, etc.) shall have adequate containment for unmitigated leaks or spills.

***Basis**: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.6.3.b.*

b. **Requirement:** The Diluent and Flush Station (containing piping, tanks, pumps, etc.) shall have the equipment foundation designed to perform the function of a secondary containment. This will consist of a curbed concrete foundation with low point sump(s). The concrete shall be coated with a chemically compatible material to prevent leaching of the sodium hydroxide into the concrete. The low point sump shall contain an alarm that is connected to the Retrieval Control System. The design shall allow a spill or release into the secondary containment to be readily removed.

***Basis**: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.6.3.b and good engineering practice.*

3.1.2.3 Chemical Unloading Equipment

a. **Requirement:** The Diluent and Flush System shall be capable of unloading and using concentrated commercial-grade sodium hydroxide (commonly referred to as caustic soda) at a concentration of up to 50 wt % provided by the DST Maintenance and Recovery Subsystem.

***Basis**: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Sections 3.1.2.1.5.a, 3.2.1.1.g, and 3.2.1.2.a.*

b. **Requirement:** The Diluent and Flush System shall be capable of unloading and using concentrated commercial-grade 40 wt % sodium nitrite ($NaNO_2$) provided by the DST Maintenance and Recovery Subsystem.

***Basis**: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Sections 3.1.2.1.5.b, 3.2.1.1.g, and 3.2.1.2.a.*

c. **Requirement:** The sodium hydroxide delivery piping from the truck loading station to the temporary storage tank shall meet the design requirements of HNF-SD-WM-TSR-006, AC 5.23 (i.e. minimum wall thickness for piping, or pressure rating of hose, maximum operating pressure, and use of polyethylene sleeving).

***Basis**: This requirement is per HNF-SD-WM-TSR-006.*

d. **Requirement:** The maximum design pressure of the system from the supply truck to the Flush and Diluent Station bulk chemical storage shall be as specified in AC 5.23 of HNF-SD-WM-TSR-006.

Basis: This requirement is per HNF-SD-WM-TSR-006.

e. **Requirement:** The Diluent and Flush Subsystem shall provide concentrated sodium hydroxide solution at a concentration up to 50 wt % to adjust the chemical composition of DSTs.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.1.e.

f. **Requirement:** The Diluent and Flush Subsystem shall be capable of adjusting the composition of sodium hydroxide from 0.010 M to <TBD> M and the composition of sodium nitrite from 0.011 M to <TBD> M to prepare needed diluent and flush solutions.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.1.f and 3.2.1.2.b.

3.1.2.4 Diluent and Flush Water Transfer Equipment

a. **Requirement:** The Diluent and Flush System shall have the capability to preheat waste transfer lines by providing a continuous flow of water or solution that is at least two times the volume of the longest planned waste transfer line volume.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.1.a.

b. **Requirement:** The Diluent and Flush System shall have the capacity to provide heated water or solution at up to 450 lbf/in^2 (3,103 kPa) at the flow rates specified in Table 3-1.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.1.b. and 3.2.1.2.d. as modified per Design Authority direction.

c. **Requirement:** The Diluent and Flush System shall have the capability to provide solutions to be used for in-line dilution for periods up to five days at the flow rate specified in Table 3-1.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.1.d as modified per Design Authority direction.

d. **Requirement:** The Diluent and Flush System Shall be capable of flushing each waste transfer line with a volume of solution that is twice the volume of the transfer line.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.2.c.

e. **Requirement:** The Diluent and Flush System shall be capable of immediately (without interruption of flow) transitioning from providing a flush solution to providing a diluent solution and from providing a diluent solution to providing a flush solution.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.m.*

f. **Requirement:** The Diluent and Flush System shall be capable of adjusting the flow rate of water or solution to support transitions from the line preheating applicable to the in-line dilution application.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.p.*

g. **Requirement:** The Diluent and Flush System shall be capable of adjusting the flow rate and chemical composition of solutions to support transitions from the in-line dilution application to the waste transfer line flush application.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.q.*

3.1.3 Boundaries and Interfaces

Subsystems that interface with the Diluent and Flush System are the Piping, Jumper, and Valve System; the Valve/Pump Pit and Cover Block System; the Mixer Pump System; the Electrical/Water Utilities System; and the Retrieval Control System. These interface relationships are illustrated in Figure 3-1.

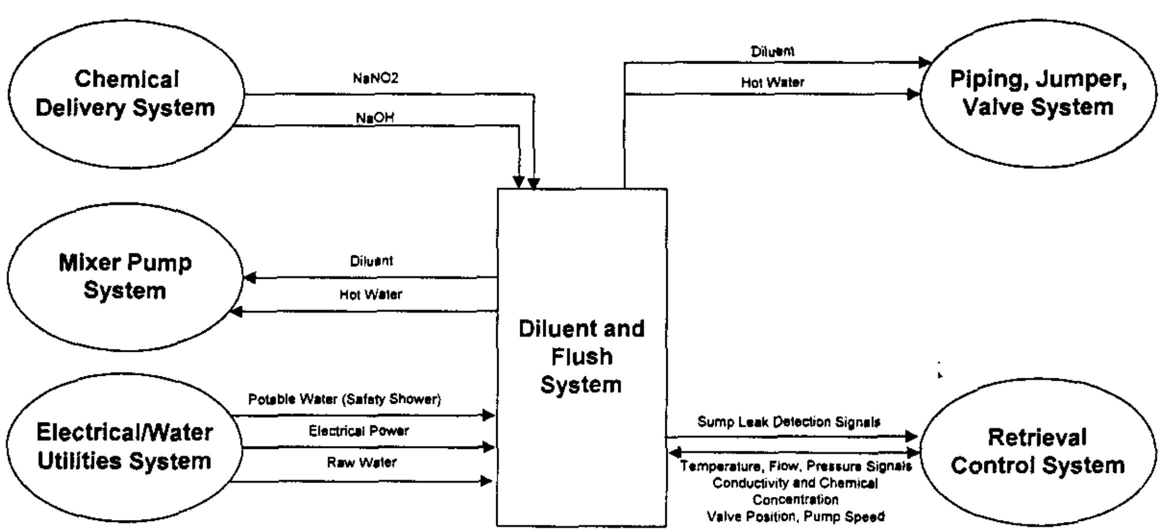

Figure 3-1. Diluent and Flush System Interfaces

3.1.3.1 Electrical/Water Utilities System

a. **Requirement:** The Electrical Utility System shall provide 480Y/277V and 208Y/120V power to the system.

Basis: Operating System Requirements. This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.1.2.1.1.a.

b. **Requirement:** The Diluent and Flush Subsystem shall be capable of receiving raw water at a continuous flow rate of at least 0.606 m^3/min (160 gal/min) and a minimum pressure of 552 kPa (80 lb/in^2 gauge).

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.1.2.1.2.a.

3.1.3.2 Retrieval Control System

a. **Requirement:** The Diluent and Flush System shall be capable of receiving industry standard control signals.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.1.2.1.4.a.

b. **Requirement:** The Diluent and Flush System shall be capable of receiving a control function to terminate diluent/flush water supply at preset volumes.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.1.2.1.4.b.

c. **Requirement:** The Diluent and Flush System shall monitor temperature, pressure, flow rate, and solution compositions.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.3.a.

d. **Requirement:** The Diluent and Flush System shall measure the quantity of heated water or solution provided to the transfer-associated structure.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.3.b.

e. **Requirement:** In the event of a loss of power, the system shall fail such that no further water or chemicals can be added to a tank.

***Basis**: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.1.3 d.*

f. **Requirement:** The Diluent and Flush System shall be controllable by the Retrieval Control System. Chemical adjustments to flush and diluent solutions, temperature adjustments of the solution, flow rate adjustments of the solutions, and the shut down of the system shall be possible from the Retrieval Control System.

***Basis:** This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.o.*

3.1.3.3 Piping, Jumper, and Valve System

a. **Requirement:** There shall be provisions for prevention and detection of backflow from the Piping, Jumper, and Valve System. Requirements for prevention and detection of waste backflow are contained in W521-SDD-05.

***Basis:** This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.h.*

3.1.3.4 Mixer Pump System

a. **Requirement:** The Diluent and Flush System shall be capable of providing water at 200 gal/min (760 L/min) to the Mixer Pump System.

***Basis:** This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.5.*

3.1.4 Codes, Standards and Regulations

Design requirements applicable to the Diluent and Flush System come from government and non-government source documents and various codes and standards. Each document (of the exact revision identified) in this section is invoked by one or more requirements of this specification and represents a part of this specification to the extent specified.

3.1.4.1 Government Documents

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State constitute a part of this specification to the extent specified herein. The regulatory documents that form a part of this specification are listed in Table 3-2.

Table 3-2. Government Documents

Document Number	Title
49 CFR 177.834, Parts (I)(2)-(5), 1999	"Carriage by Public Highway," "General," *Code of Federal Regulations*, as amended.
DOE 6430.1A, 1989	*General Design Criteria*, U.S. Department of Energy, Washington, D.C.
WAC 173-401, 1999	"Operating Permit Regulations," *Washington Administrative Code*, as amended.

3.1.4.2 Non-Government Documents

National codes, standards, and the Hanford Site documents listed in Table 3-3 constitute a part of this specification to the extent specified herein. Note: The RPP-PROs implement federal and state regulations and DOE orders. In addition, it should be noted that some requirements are based on the existing authorization basis documents (HNF-SD-WM-SAR-067, HNF-SD-WM-TSR-006, etc.). The Authorization Basis requirements may be changed, if necessary, after analysis and justification of the resulting risk being incurred have been outlined in a final safety analysis report (FSAR) amendment and approval is obtained from DOE Office of River Protection. In addition, the list of procedures is not intended to be complete, but rather to identify key ones which, when implemented, will support successful completion of design activities. Specific other procedures/documents are referenced throughout the sections of this document.

Table 3-3. Non-Government Documents

Document Number	Title
AASHTO, H20-44, 1996	*Standard Specification for HS-20, Highway Loading*, American Association of State Highway and Transportation Officials.
ASME B31.3, 1999	*Process Piping*, American Society of Mechanical Engineers, New York, New York.
ANSI Z358.1-1990	*Emergency Eyewash and Shower Equipment*, American National Standards Institute.
ASME NQA-1, 1994	*Nuclear Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
RPP -PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP -PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP -PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP -PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP -PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP -PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP -PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*
RPP -PRO-709, Rev. 0, 1999	*Preparation and Control Standards for Engineering Drawings.*
RPP -PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP -PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP -PRO-1819, Rev. 0, 1999	*PHMC Engineering Requirements.*
HNF-2962, 1998	*A List of Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC) Requirements*, Numatec Hanford Corporation for Fluor Daniel Northwest for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 1A, 1999	*RPP Administration* , "Tank Farm Operations Equipment Labeling," Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-MP-599, Rev. 3, 1999	*Project Hanford Quality Assurance Program Description*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TSR-006, Rev. 0-R, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
WHC-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
WHC-SD-WM-HSP-002, Rev. 3A, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.

3.1.5 Operability

Operability requirements shall, in general, be consistent with commercial practices. Specific requirements shall be specified during definitive design.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

The system is not expected to be in direct contact with the waste and is not expected to see any general area radiation beyond a few mrem/hr at the piping interface with the Piping, Jumper, and Valve System.

a. **Requirement:** The Diluent and Flush System equipment shall be capable of receiving and mixing concentrated caustic solutions obtained from a supplier that are up to 50 wt %.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.5.2.1.a.

b. **Requirement:** The Diluent and Flush Subsystem equipment shall be capable of receiving and mixing concentrated and nitrate solutions obtained from a supplier that are up to 40% wt %.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.5.2.1.b.

c. **Requirement:** All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, 1300-11.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.8.a.

3.2.2 ALARA

a. **Requirement:** The Diluent and Flush System shall be designed to keep personnel exposure as low as reasonably achievable (ALARA) in accordance with RPP-PRO-1621 and RPP-PRO-1622.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.6.1.b.

3.2.3 Nuclear Criticality Safety

N/A

3.2.4 Industrial Hazards

a. **Requirement:** The system shall incorporate occupational safety and health design features that comply with the requirements of HNF-SD-WM-HSP-002.

__Basis:__ This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.6.1.a.

b. **__Requirement__:** Safety shower and eyewash stations shall be provided at the diluent and flush stations and shall comply with ANSI Z358.1.

__Basis:__ This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.6.1.c.

3.2.5 Operating Environment and Natural Phenomena

a. **__Requirement:__** The system shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501.

__Basis:__ This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.5.1.a.

b. **__Requirement__:** The system shall be designed to withstand the natural phenomena hazards as specified in LMH-PRO-097.

__Basis:__ This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.5.1.b.

c. **__Requirement__:** The containment skid shall be resistive to pressure gradients above and below the foundation and shall be capable of preventing failure caused by settlement, compression, or uplift.

__Basis:__ This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.5.1.c.

3.2.6 Human Interface Requirements

a. **__Requirement__:** The Diluent and Flush System design shall comply with DOE 6430.1A, Section 1300.12, "Human Factors Engineering."

__Basis:__ This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.7.a.

3.2.7 Specific Commitments

No specific commitments have been identified.

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

a. **Requirement:** All concrete work shall meet the applicable design and construction requirements contained in ACI 318.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.c.

b. **Requirement:** Buried portions of the diluent and flush supply lines shall be back-filled with a noncorrosive, porous, homogenous medium to ensure that the piping is fully and uniformly supported.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.f.

3.3.2 Mechanical and Materials

a. **Requirement:** The piping shall meet the applicable design and construction requirements contained in ASME B31.3.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Sections 3.3.1.a.

b. **Requirement:** All valves shall meet the applicable design and construction requirements contained in ASME B16.34.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Sections 3.3.1.b.

c. **Requirement:** Polyethylene (or equivalent) sleeving shall be provided around sodium hydroxide delivery piping.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.i.

d. **Requirement:** For the connection to the Transfer Valving Subsystem, the Diluent and Flush System shall use material that can be welded to 304L stainless steel and is compatible with 304L stainless steel.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.k.

e. **Requirement:** The Diluent and Flush Subsystem shall comply with "Carriage by Public Highway," "General," Title 49 CFR 177.834, parts (1)(2)-(5), during tanker unloading.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.l.*

f. **Requirement:** The piping for conveying dilute sodium nitrate and sodium hydroxide solutions from the Diluent and Flush System to the appropriate valve pit shall meet the requirements of DOE 6430.1A, Sections 1300-7.1 and 1300-7.4.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.n.*

g. **Requirement:** The diluent/flush supply piping to the valve and pump pits shall have a design pressure rating at least 450 lbf/in^2 (3,103 kPa).

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.r, as modified per Design Authority direction.*

h. **Requirement:** The Diluent and Flush Subsystem shall be designed and operated such that water hammer events are precluded from occurring, or an analysis is performed to determine the adequacy of the design to handle maximum water hammer events.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.6.2.a.*

3.3.3 Chemical and Process

a. **Requirement:** Dry disconnect couplings shall be provided for connections to the chemical supply truck.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.e.*

3.3.4 Electrical Power

a. **Requirement:** Electrical equipment enclosures shall be, as a minimum NEMA Type 4 or 4X, per industrial controls and systems, NEMA ICS 6. Electrical enclosures shall have the cover secured by a toggle-actuated handle to minimize difficulties in opening and fully securing the enclosure.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.d. Note: the Design Authority is processing paperwork to resolve issue. Electrical enclosures and junction boxes of the proper NEMA rating shall be utilized.*

b. **Requirement:** Electrical materials and equipment shall be Underwriters Laboratories (UL) or factory-mutual tested, with label attached, for the purpose intended, whenever such products are available. Where no UL or factory-mutual listed products of the type are available, testing and certification by the RPP Design Authority in conjunction with the Flammable Gas Equipment Advisory Board or by a nationally recognized testing laboratory (NRTL) shall be acceptable.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 4.1.2.

3.3.5 Instrumentation and Control

a. **Requirement:** The Diluent and Flush System routing valves shall be provided with position switches.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.1.g.

b. **Requirement:** The system shall comply with electromagnetic radiation emission requirements set forth in HNF-2962.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.2.

3.3.6 Computer Hardware and Software

No computer hardware and software requirements are identified.

3.3.7 Fire Protection

No fire protection requirements are identified for the Diluent and Flush System.

3.4 Testing and Maintenance Requirements

3.4.1 Testability

Testing features shall be designed to implement testing requirements. System design shall incorporate features for verifying system operability.

3.4.2 TSR-Required Surveillance

There are no TSR Related Surveillances identified at this time for the Diluent and Flush System.

3.4.3 Non-TSR Inspections and Testing

a. **Requirement**: Seat closure tests shall be performed for diluent and flush valves in accordance with the test methods in ASME B16.34 and API-598. Seat leakage from each flow side to the isolated port shall be within the limits specified in API-598.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 4.1.2.a, as modified by engineering judgment.

b. **Requirement:** Shell tests shall be performed for diluent and flush valves in accordance with ASME B16.34.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 4.1.2.b.

3.4.4 Maintenance

a. **Requirement**: Mean time to repair for the Diluent and Flush System, during unplanned outages, shall be less than 24 hours. This time does not include logistics delay time or administrative delay time.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.4.a.

b. **Requirement**: A single replaceable component of the Diluent and Flush System shall be designed to enable replacement within eight hours. This time does not include logistics delay time or administrative delay time.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.4.b.

c. **Requirement:** The diluent and flush supply lines shall be designed to require no maintenance.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.5.1.b.

3.5 Other Requirements

3.5.1 Security and SNM Protection

No security or SNM issues are associated with this system.

3.5.2 Special Installation Requirements

a. **Requirement:** Consideration shall be given to the use of "hose bibs" from the Diluent and Flush System to be used as a source of hot water for washing equipment removed from the tanks.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.7.*

3.5.3 Reliability, Availability, and Preferred Failure Modes

a. **Requirement:** The design life of the Diluent and Flush System shall be 35 years. Replacement of major components is allowable if this is the most cost-effective approach.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.3.a.*

b. **Requirement:** The Diluent and Flush System shall be capable of providing heated diluent/flush water after a single failure of an active component.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.3.b.*

c. **Requirement:** The Diluent and Flush System shall allow for local restart by the operator following actuation of a leak detector for the purpose of flushing the line.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.2.3.c.*

3.5.4 Quality Assurance

a. **Requirement:** Quality assurance for the Diluent and Flush System shall be performed in accordance with HNF-IP-0842, Volume XI, Section 1.0.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 4.0.*

b. **Requirement:** Design verification shall be performed on the Diluent and Flush System subject to the procedure identified in RPP-PRO-1819, Section 2.9.1.

Basis: *This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 4.2.*

3.5.5 Miscellaneous

a. **Requirement:** The system shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.3.3.a.

b. **Requirement:** All chemical and other pipelines shall be individually marked in accordance with DOE Order 6430.1A, Section 1323.4.3.

Basis: This requirement is per HNF-4163, Level 2 Specification for the Diluent and Flush System, Section 3.3.3.b.

c. **Requirement:** Records, documents, and drawing control pertinent to design functions shall be in accordance with RPP-PRO-222, and RPP-PRO-224. Engineering document development shall be in accordance with RPP-PRO-709.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.4.a.

d. **Requirement:** All SSCs shall be incorporated into the master equipment list in accordance with HNF-IP-0842, Volume II, Section 6.1.

Basis: This requirement is per HNF-4163, Double-Shell Tank Diluent and Flush Subsystem Specification, Rev. 0, Section 3.4.b.

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

4.1.1 Description of System, Subsystems and Major Components

The major components of the Diluent and Flush System consist of chemical tanker offload equipment, a package water heater with associated support equipment, metering pumps for chemical injection, a static mixing tee, a mixing and storage tank, supply pumps, valves, piping, and instrumentation used for monitoring and control. This equipment will be used to supply treated water to the waste transfer piping system to be routed for in-tank or in-line dilution, transfer pipeline pre-heating, and transfer line/pump flushing. For in-line and in-tank dilution, the dilution ratio will be adjusted to attain the required fluid properties for transfer and storage. Waste parameters will be monitored in tank and at transfer pump outlet and will be used to determine the properties of the waste. These parameters include density, flow, temperature, and pressure.

Radiation detectors are provided at the point where the piping system goes underground to monitor for backflow of waste to provide detection and alarm for personnel protection.

Heat trace will be provided to prevent freezing of the components during cold weather. Equipment such as pumps and associated controls will be housed in heated enclosures or rated for outdoor use.

The following sections provide a brief description of major components in the Diluent and Flush System. A simplified P&ID of the system is shown in Figure 2-1.

4.1.1.1 Heating Equipment

A packaged hot water heating system, will be used to heat the raw water for use in the AW Farm dilution system. The system will be a self-contained, skid-mounted, electrical water heater that is capable of providing 53 gpm at 155 °F. Heater sizing is based on anticipated in-line dilution continuous flowrate of 53 gpm.

The existing hot water heating system, installed by project W-058, will be modified to heat the raw water for use in the SY Farm dilution system. The system consists of two 500 kW electric water heaters mounted on a common skid, capable of providing approximately 65 gpm at 150 °F. An additional 135 Kw Electrical Heater will be installed. This heater size is sufficient based on a continuous in-line dilution flowrate of 53 gpm and preheating the cross-site transfer lines.

During the definitive design process, the capability of existing electrical infrastructure, including incoming electrical lines and transformers shall be assessed. Dyncorp and Parsons Infrastructure and Technology Group, and Facility Electrical Engineering shall review and approve the assessment, any calculations, and electrical load design drawings. The design will either not exceed the current electrical capabilities, or provide for and required upgrades. The related facility calculation updates shall be completed and addressed as part of the project ABU.

4.1.1.2 Diluent and Flush Structures

Two flexible connections will be provided to allow parallel connection of two tanker trucks to the system. Chemicals to be off loaded include sodium hydroxide for pH control and sodium nitrite for corrosion prevention. Truck parking area(s) are bermed to contain the chemicals, should the contents of tanker leak to the ground. A roof structure will be provided to minimize water intrusion/collection.

4.1.1.3 Chemical Unloading Equipment

The hot water/chemical supply system will deliver a nominal flowrate of 53 gpm of up to 19 Molar (M) of sodium hydroxide and up to 10 M of sodium nitrite at up to 155°F out to the valve pits for routing to the transfer pump pit, mixer pump pit, or valve pits. Positive displacement pumps will inject the chemicals into the heated raw water as it exits the water heater system. The hot water and the chemicals will be mixed in an in-line static mixer. Flowrate and density of the solution will be monitored to ensure the desired diluent concentrations are achieved.

The chemical solution can be routed into a storage tank that will have a temperature control system to maintain the temperature of the solution for storage and eventual use or the solution can be routed directly to the waste transfer line for in-line/in-tank dilution at a 53-gpm flowrate. The storage tank is sized such that it can provide 2 line volumes of diluent for transfer line post transfer flushing in a batch operation. Preliminary calculations of the maximum line length from the AW Farm Diluent and Flush System skid to the WTF indicate that a volume of 2 x 1,100 gallons is needed for the post transfer flush. Although the total volume equates to 2,200 gallons, plus 140 gpm for 30 min. a minimum tank size of 10,000 gallons will be used to allow for future needs. The maximum line length for the SY Farm Diluent and Flush System skid is associated with flushing the cross-site transfer line. The current operating procedure indicates that 1 x 13,600 gallons is needed for the post transfer flush. The total volume equates to 13,600 gallons. A feed and bleed approach will be used whereby the tank will be continuously filled with heated water at the rate of 60 gpm during the 140 gpm flushing operation. The design of the SY Farm diluent system will include a storage tank with a nominal capacity of 20,000 gallons.

The diluent/flush pump (60 hp) at the storage tank discharge is sized to deliver a maximum flow rate of 140 gpm. A ½ Hp pump will provide a recirculation mixing capability for the tank contents.

4.1.1.4 Diluent and Flush Water Transfer Equipment

A new 3 in. raw water line will be required for supplying water to the hot water heater for the AW Farm system. The new line will tie into the existing raw water distribution system line. A certified reduced pressure backflow prevention assembly will be installed at the tie-in to the raw water for cross-connection contamination control.

New underground piping for the Diluent and Flush System will be epoxy coated and insulated for corrosion protection and heat retention.

The piping will be designed in accordance with the requirements of ASME B31.3. The material selection will be consistent with current RPP Project W-211. The Diluent and Flush System will be designed with a minimum slope of 1/8 inch per foot as required for gravity drain lines per UPC. If this is not feasible due to existing obstructions, then the lines will incorporate a continuous slope of at least 0.25%.

4.1.1.5 Low Point Sump Leak Detection Sensors

Low point sump leak detectors shall be provided to detect chemical leakage from the Diluent and Flush System piping or accumulations of fluids in the low point sump. The leak detection system will serve to detect a leak to allow for timely response to mitigate the leak.

4.1.2 Boundaries and Interfaces

Systems that interface with the Diluent and Flush System are the Piping, Jumper, and Valve System, the Electrical/Water Utilities System, the Mixer Pump System, the Retrieval Control System, and the Valve/Pump Pits/Cover Block System. The diluent and flush lines enter the Valve/Pump Pits/Cover Block System through a core-drilled hole in the side of the valve pits. The diluent and flush solutions are transferred through the piping and interface with the Piping, Jumper, and Valve System at a PUREX-type connector anchored to the transfer-associated structure. The Diluent and Flush System metering pumps, supply pumps, valve actuators, and instrumentation interface with the Electrical/Water Utilities System and the Retrieval Control Subsystem above grade junction boxes and at plugged connections. Additionally, the Diluent and Flush System interfaces with the Electrical/Water Utilities System at the branch point off of the main raw water distribution system and feeds water to the Mixer Pump System.

4.1.3 Physical Location and Layout

The Diluent and Flush System components are proposed to be located on the west side of the 241-AW Farm. This location has been selected based on proximity to the AW Farm valve pits and space available for the water heater package, diesel fuel tank, storage tank, pumping and instrument enclosures, and chemical off-load equipment. The SY Farm, Diluent and Flush System are located northwest of the farm and directly adjacent to the 242-S evaporator.

4.1.4 Principles of Operation

4.1.5 System Reliability Features

The current concept for ensuring a reliable Diluent and Flush System is to provide the following:

- Redundant supply pumps, one primary and one backup,
- Redundant metering pumps , and
- Redundant Variable Speed Drives for each of the pumps to supply power and control pump speed.

These are some of the features that increase the reliability of the Diluent and Flush System. The reliability features of this system will be further defined as the design develops.

4.1.6 System Control Features

4.1.6.1 System Monitoring

Capability will be provided by the Retrieval Control System to monitor Diluent and Flush System parameters at the AW Farm Instrument Control and Electrical (ICE) Human Machine Interface (HMI). This includes pump status, tank status, valve status, water heater status, and system flow, pressure and temperature status and chemical concentration. The individual parameters are described in detail in W-521-SDD-04, Retrieval Control System SDD.

<u>Safety Significant</u>

- Local flow totalizers will be utilized to indicate total additions of diluent and/or flush water flow.

4.1.6.2 Control Capability and Locations

A Diluent and Flush control system is required to control process variables at desired levels.

The Diluent and Flush control system shall have stand-alone local monitor and control capability. Under normal operations the system will be started in local mode, and continued operation will be monitored and controlled in remote mode using the AW Farm ICE HMI.

These parameters to be controlled include water heater outlet temperature, storage tank temperature and level control, pump speed and outlet flow control for diluent flow adjustments, and flow control for the metering pumps to assure correct chemical concentration of the solution is maintained. The system control features for the Diluent and Flush System are further described in the W-521-SDD-04, Retrieval Control Subsystem SDD. Capability will be provided for execution of monitoring and control functions from the AW Farm ICE Building local-remote HMI.

4.1.6.3 Automatic and Manual Actions

Supply and metering pumps will automatically shut down upon activation of the transfer line leak detection sensors. This capability is necessary in order to assure diluent flow to the waste transfer system is stopped when the master pump shutdown system initiates a shutdown for the transfer. Capability for manual restart of the flush system is provided in order to perform post shutdown flush as desired.

4.1.6.4 Setpoints and Ranges

Setpoints and ranges will be defined as the design progresses.

4.1.6.5 Interlocks, Bypasses and Permissives

These controls will be defined as the design progresses.

4.2 Operations

The WFD Operations and Maintenance (O&M) Philosophy provides the project with constraints and guidance on system operations and developing operations procedures. The O&M Philosophy and the WFD O&M Concept (HNF-1939) are the primary bases for developing the Project Operations Plan. The O&M Concept is strongly influenced by the primary interfaces with the WTF. Significant penalties and/or increased costs may be incurred for failure to provide waste feed of sufficient quality and quantity. Therefore, new facilities and upgrades of existing facilities are being designed such that there is minimal disruption of WFD due to system failures. System design and operation is optimized to support availability, reliability, and accommodate parallel processes where appropriate. Most of the concepts in the O&M Philosophy are related to keeping the WFD systems operating while supplying feed to the WTF and minimizing the shutdown time necessary for maintenance and repairs.

Systems are designed to be as reliable as possible with little or no preventive maintenance or testing. The higher initial costs associated with more robust SSCs will be recovered through reduced down time, repairs, and avoiding contractual costs from the inability to provide feed to the WTF. The Operations Plan and Operations Procedures are developed in coordination with interfacing projects to ensure a consistent O&M concept is implemented for all waste retrieval systems supporting WFD. The guidance for preparation and content of operations documentation is provided in HNF-IP-0842, Volume IV, Section 2.15 "Operations and Maintenance Planning Process" and on the RPP Systems Engineering Web Site.

Prior to each initial system startup, readiness to start-up will be verified to meet the intent and requirements of the RPP procedure for facilities startup and readiness, RPP-PRO-55 "Facilities Start-Up Readiness" which implements U.S. Department of Energy (DOE) Order 425.1, *Startup and Restart, of Nuclear Facilities.* The level and type of review will be conducted at the lowest practical level commensurate with the project safety risk.

4.2.1 Initial Configuration (Pre-Startup)

Pre startup configuration will be determined based on manufacturers recommendation.

4.2.2 System Start-up

Vendor representatives will provide supervision during system startup.

4.2.3 Normal Operations

New systems will be operated in accordance with the approved operating procedures prepared for the system.

4.2.4 Off-Normal Operations

Off-normal operations will be covered in the applicable operating and emergency response procedures. Generally, the response to any off-normal situation will be to place the system in a safe, shutdown condition if initial operator response does not mitigate the situation. The on-duty operators may perform this shutdown in a controlled manner manually from the control area, or it may occur automatically, depending on the speed necessary to place the system in a safe condition.

4.2.5 System Shutdown

The systems will be shutdown as part of their respective operating procedures.

4.2.6 Safety Management Programs and Administrative Controls

These controls will be defined as the design progresses.

4.3 Testing and Maintenance

4.3.1 Temporary Configurations

In order to perform some maintenance and testing activities, it may be necessary to align the system other than for normal operations. Any situations requiring temporary configurations will be controlled via formal work procedures to ensure normal system configuration is restored when the maintenance or testing activity is complete. Under no circumstances will the system be allowed to operate with a temporary configuration until a formal temporary procedure change is written and approved. This procedure change process will ensure a USQ screening is performed and that the system will not be operated outside of its Authorization Basis.

4.3.2 TSR-Required Surveillance

No TSRs required surveillances are identified at this time.

4.3.3 Non-TSR Inspections and Testing

Specific non-TSR inspections and testing for the Diluent and Flush System have not been identified. However, appropriate preventive and predictive maintenance will be performed to maintain the equipment in a satisfactory condition throughout the design life.

4.3.4 Maintenance

4.3.4.1 Post Maintenance Testing

Specific post maintenance testing activities for the system have not been identified. However, post maintenance testing will be conducted to ensure maintenance is properly performed, the identified/original deficiency is corrected, and the equipment is restored to an operational status. The rigor of post maintenance tests will be based on the extent of maintenance performed and the importance to plant/system safety and reliability. Post maintenance testing will be performed and documented in accordance with HNF-IP-0842, Volume V, Section 7.2 "Post Maintenance Testing" and HNF-IP-0842, Volume IV, Section 4.28 "Testing Practices Requirements".

4.3.4.2 Post-Modification Testing

Specific post maintenance testing activities for the system have not been identified. However, post modification testing will be essentially the same as post maintenance testing. It is performed to ensure that the safety related functions of a system still perform satisfactorily after the system or equipment has been modified. Post modification testing is performed in accordance with the same guiding documents used for post maintenance testing.

ELECTRICAL/WATER UTILITIES SYSTEM DESIGN DESCRIPTION

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Task 00008
Report No. W-521-SDD-02
Revision 2

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Prepared by: Dick Golberg, P.E.
Tom Salzano, P.E.

Approved by: RLFritz
Robert L. Fritz

Date: 9-30-00

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Acronyms

ACD	Advanced Conceptual Design
ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
CDAS	Caustic Diluent Addition System
DOE	U.S. Department of Energy
DST	Double-Shell Tank
ECN	Engineering Change Notice
FSAR	Final Safety Analysis Report
GS	General Service
HLW	High Level Waste
I&C	Instrument and Control
ICS	Industrial Controls and Systems
IESNA	Illuminating Engineering Society of North America
IEEE	Institute of Electrical and Electronics Engineers
LAW	Low Activity Waste
MCC	Motor Control Center
NEMA	National Electrical Manufacturers Association
NUREG	U.S. Nuclear Regulatory Commission
ORP	Office of River Protection
RPP	River Protection Project
SC	Safety Class
SDD	System Design Description
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To be determined
TBR	to be refined
TSR	Technical Safety Requirements
TWRS	Tank Waste Remediation System
UL	Underwriters Laboratories
UPC	Uniform Plumbing Code
UPS	Uninterruptible Power Supply
VFD	Variable Frequency Drive
WAC	Washington Administration Code
WFD	Waste Feed Delivery
WFDS	Waste Feed Delivery System
WTF	Waste Treatment Facility

1.0 INTRODUCTION

This System Design Description (SDD) identifies performance requirements, defines bases, and provides references to requisite codes and standards for the Waste Feed Delivery System (WFDS) Project W-521 Electrical/Water Utilities System. This system provides electrical power and raw/potable water to equipment and structures used to transfer low activity waste (LAW) and high-level waste (HLW). This revision incorporates Level 2 requirements as specified in HNF-4157, Rev. 0, *Double-Shell Tank Utilities Subsystem Specification.* There are no service/instrument air modifications in the WFDS Project scope, therefore, those subsystems are not addressed in this SDD.

1.1 System Identification

The Electrical/Water Utilities System described in this SDD provides the electrical power to mixer, transfer, and diluent pump motors; and to the Retrieval Control System (RCS). In addition, it supplies raw water for transfer line dilution/flushing and for mixer pump fill and sparging. Finally, the system supplies potable water to structures and equipment within the project scope.

The Electrical/Water Utilities System will provide utilities to each of the nine tanks included within the scope of Project W-521. The tanks included are as follows: 241-AW-101, 241-AW-103, 241-AW-104, 241-AY-101, 241-AY-102, 241-SY-101, 241-SY-102, 241-SY-103. Valve pits for the AP tank farm and the Waste Treatment Facility (WTF) are also included.

The Electrical/Water Utilities System is comprised of the following major subsystems:

- Electrical Power,
- Raw Water, and
- Potable Water.

1.2 Limitations

This SDD does not include the delivery of electrical power and raw/potable water to each DST farm as these utilities are under the exclusive control of DynCorp Tri-Cities Services, Inc.

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary or of a highly conceptual nature. This SDD will be a living document throughout the design phases of W-521, and will become more detailed as the design progresses through Definitive Design. Requirements were taken from the *Double Shell Tank Utilities Subsystem Specification*, HNF-4157, Rev. 0.

1.3 Ownership

This SDD is owned by the Project Engineers responsible for the Electrical/Water Utilities System.

1.4 Definitions

Active – An active component is one that is part of the "as-built" tank farms and has not been isolated and disconnected from all other tank farm components as part of an approved Engineering Change Notice (ECN).

Administrative Lock – A locking device that prevents inadvertent equipment start. Administrative locks ensure that the equipment or systems(s) being isolated and/or controlled cannot be operated (e.g., removing the motive force of a transfer pump [e.g., electrical power, steam, water, or air] and installing an administrative lock so that the transfer pump cannot be activated) until the administrative lock is removed.

General Service (GS) SSC – Structures, systems, or components (SSCs) not classified as either Safety Class or Safety Significant.

Manifold – Remotely installed rigid piping system inside a pit that transfers waste and flush water between nozzles.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

  - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
  - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
  - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
  - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
  - Two Safety – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

  (**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

RPP Design Authority – A person qualified in the practice of engineering with four years demonstrated job related experience including two years in their specific functional areas. For nuclear structures, systems, or components, they shall have at least one-year nuclear experience. The RPP Design Authorities for the facility and for the Project must have completed the RPP Design Authority Qualification Card and have an appointment letter approved by the RPP Chief Engineer.

Safety Class (SC) SSC – An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant (SS) SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall – Denotes a requirement.

Should – Denotes a recommendation. If a “should” requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

To Be Determined (TBD) – A study and/or calculation needs to be performed in order to provide a sufficient technical basis for the requirement.

To Be Refined (TBR) – To be refined. A “soft” basis for the requirement has been identified. However, a further study and/or calculation needs to be performed in order to solidify the requirement’s technical basis.

2.0 GENERAL OVERVIEW

2.1 System Functions

The overall mission of the Electrical/Water Utilities System is to provide electrical power and raw/potable water to support systems that are used for the following:

- to maintain safe storage within the DSTs,
- to process, stage and transfer LAW and HLW feed to the WTF, and
- to receive and manage routine waste receipts.

The following sections list the functions of the electrical and raw/potable water systems. Section 4 of this document identifies the specific scope associated with W-521.

2.1.1 Electrical Power System

The electrical power system must meet the requirements of the following functions:

- Distribute electrical power,
- Provide 480Y/277 V Distribution Equipment,
- Provide 240/120 and 208Y/120 V Distribution Equipment, and
- Provide lighting.

2.1.2 Raw/Potable Water

The raw/potable water systems must meet the requirements of the following functions:

- Provide Strained Raw Water,
- Provide 75 micron Filtered Raw Water,
- Provide 5 micron Filtered Raw Water, and
- Provide potable water for safety showers and eyewash stations.

2.2 System Classification

The Electrical/Water Utilities Systems are classified as General Service, (GS) with the exception that the backflow preventer on the Raw Water system is classified as Safety Significant (SS).

2.3 Basic Operational Overview

The following sections provide a brief overview of the sub-elements of the Electrical/Water Utilities.

2.3.1 Electrical Power Distribution System

The electrical power distribution system provides the normal electrical power to the AP-, AW-, AY-, and SY-Tank Farms. This system supplies the 480Y/277 V and 208Y/120 V and 240/120 V power for all of the pumps and process equipment within the tank farm and other equipment (e.g., pole-mounted lights). Project W-521 will install a new 1000 kVa 13.8 kV - 480Y/277 V pad-mount transformer for the AY-Tank Farm. The existing SY Tank Farm 480Y/277 V transformers are not adequately sized for the existing loads and the projected new mixer pumps and other equipment to support the WFD mission. Two new 13.8 kV – 480Y/277, 1500 kVA transformers will be installed by W-521. Project W-521 will install a new 13.8 kV - 480Y/277 V 2000 kVA pad mounted transformer to replace the existing 500kVA transformer for the AW-Tank Farm. New switchboards and variable frequency drive (VFDs) will be installed for the new mixer and transfer pumps in the AW-, AY-, and SY-Tank Farms.

2.3.2 Raw/Potable Water

The Central Plateau Water System (operated by DynCorp) delivers raw and potable water to the DST Farms. The raw water distribution infrastructure receives raw water from two reservoirs located near the 100B and 100D reactor facilities. The water is distributed from these reservoirs through an underground main piping system and then supplied to each tank farm via a branch feeder. The raw water is also supplied to a filtration plant in the 200 West area and converted to potable water. This potable water is then distributed to tank farms within the 200 West and 200 East areas.

The raw water distribution system within the tank farms consists of piping, filters, service pits, and related components that distribute raw, and strained water to tank farm equipment. Potable water is used in safety showers and eyewash stations.

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section identifies the general requirements for the Electrical/Water Utilities System and the bases for these requirements.

3.1.1 System Functional Requirements

a. **Requirement:** The Electrical/Water Utilities System shall transform, control, protect, and distribute electrical power to support the operations and maintenance electrical loads.

   Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.1.*

b. **Requirement:** The Electrical/Water Utilities System shall light exterior and interior portions of the DST system to facilitate operations and maintenance.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.1.2.*

c. **Requirement:** The Electrical/Water Utilities System shall control and distribute raw water to support operations, including water needed for industrial safety and fire protection.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.2.*

d. **Requirement:** The Electrical/Water Utilities System shall control and distribute potable water to the diluent/flush system.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.3.*

3.1.2 Subsystem and Major Components

3.1.2.1 Distribute Electrical Power

a. **Requirement:** The electrical distribution system should have a leading or lagging power factor of not less than 85 percent.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.1.a.*

3.1.2.2 Distribute 480Y/277 V Electrical Power

a. **Requirement**: The 480Y/277 V electrical distribution system shall support the electrical load characteristics for each DST Farm based on RPP-5228.

Basis: *These requirements are per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.1.1.a.*

b. **Requirement**: The electrical distribution system shall provide voltage regulation in compliance with latest version of ANSI C84.1.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.1.1.b.*

3.1.2.3 Distribute 240/120 V or 208Y/120 V Electrical Power

a. **Requirement:** The electrical distribution system shall provide 240/120 V or 208Y/120 V services to utilize equipment within the W-521 scope.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, 3.2.1.1.3.a.*

3.1.2.4 Provide DST Lighting

a. **Requirement:** Exterior and interior lighting shall comply with The IESNA Lighting Handbook.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.1.2.a.*

3.1.2.5 Distribute Raw Water

a. **Requirement:** Actual tank farm raw water loads shall be as determined by detailed design and controlled by xx-xxx <TBD>, *Tank Farm Contractor Water Load Study.*

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.2.a.*

b. **Requirement:** The raw water system shall provide connections to allow up to 200 gal/min (12.6 L/s) of strained water at 80 lbf/in^2 gauge (552 kPa) to the DST Maintenance and Recovery System.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.2.b.*

c. **Requirement:** For raw water lines entering a tank farm or radiation zone, cross connection control devices (backflow prevention assemblies) shall be installed to prevent contamination of the potable water supply. Cross connection control shall be in accordance with Washington State cross connection control regulations (RCW 19.27 and WAC-246-290-490). Backflow prevention assemblies. The devices shall be installed and the installation shall be tested in accordance with the Manual of Cross-Connection Control published by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, and the Cross-Connection Control Manual, Accepted Practice and Procedure published by the pacific Northwest Section of the American Water Works Association.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.3.b.*

d. **Requirement:** For branch lines in the Central Plateau Raw and Potable Water Distribution systems, the raw and potable water subsystem shall provide flow meters capable of sending compatible signals to the Retrieval and Control System for totalizing flows for leak-detection analysis. Flow meters shall include local indication.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.3.e.*

e. **Requirement:** When piping branches of the Raw Water Subsystem can be connected such that there is potential contamination to the subsystem piping, the branch line(s) shall be equipped with backflow prevention devices to prevent contamination via siphoning or backflow of waste.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.3.f.*

3.1.2.6 Distribute Strained Raw Water within the DST System

a. **Requirement:** The strained raw water system shall provide strained raw water to the mixer pump raw water filters for distribution of filtered raw water to the mixer pumps seals, sparger ring, and column fill. As a minimum, the water shall be strained to eliminate particulates greater than <TBD>.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.2.c.*

b. **Requirement:** Where strained raw water can be connected to sources of contamination, a backflow prevention device shall be installed between the potential contamination source and the strained water piping. A pressure switch with interlock, or isolation with two closed valves and a pressure switch, may be used.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.2.d.*

3.1.2.7 Distribute 75-micron Filtered Raw Water within the DST System

a. **Requirement:** Strained raw water shall be filtered to a maximum of 75-microns and provided to the mixer pump sparger ring.

Basis: *This requirement is to support requirements in W-521-SDD-03, Mixer Pump System Design Description.*

b. **Requirement:** Filtered raw water to the mixer pump sparger ring shall be delivered to the mixer pump via a temporary hose (i.e., not a permanent filtered raw water connection to the mixer pump).

Basis: *This requirement is to support requirements in W-521-SDD-03, Mixer Pump System Design Description.*

3.1.2.8 Distribute 5-micron Filtered Raw Water (Service Water) within the DST System

a. **Requirement**: Strained raw water shall be filtered to a maximum of 5-microns (Service Water) and provided to the mixer pump upper mechanical seals and column fill.

Basis: This requirement is to support requirements in W-521-SDD-03, Mixer Pump System Design Description.

b. **Requirement**: Service water to the mixer pump column fill shall be delivered to the mixer pump via a temporary hose (i.e., not a permanent service water connection to the mixer pump).

Basis: This requirement is to support requirements in W-521-SDD-03, Mixer Pump System Design Description.

c. **Requirement**: Service water to the mixer pump mechanical seals shall be delivered via permanent service water connections to the mixer pump.

Basis: This requirement is to support requirements in W-521-SDD-03, Mixer Pump System Design Description.

3.1.2.9 Distribute Potable Water within the DST System

a. **Requirement**: Actual tank farm potable water loads shall be as determined by detail design and controlled by xx-xxx <TBD>, *Tank Farm Contractor Water Load Study.*

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.1.3.a.

b. **Requirement**: Potable water shall be provided to safety showers and eye wash stations near the Chemical Addition/Diluent System.

Basis: This requirement is to support requirements in W-521-SDD-01, Diluent and Flush System Design Description.

Note: Potable water is required within the Scope of W-521 only to the eye wash station on the AW and SY Tank Farm Diluent Systems.

3.1.3 Boundaries and Interfaces

3.1.3.1 Electrical Power System Interfaces

Subsystems that interface with the Electrical Power System are shown in Figure 3-1. The interface points between the DST Farm electrical distribution system and the other DST systems is generally at the secondary side of the feeder breaker providing electrical power to the equipment. For safety classified circuits, which are not designed as fail safe, the feeder breaker shall be included as part of the safety classified system. Equipment controls are considered part of the equipment and are not part of the Electrical Power System.

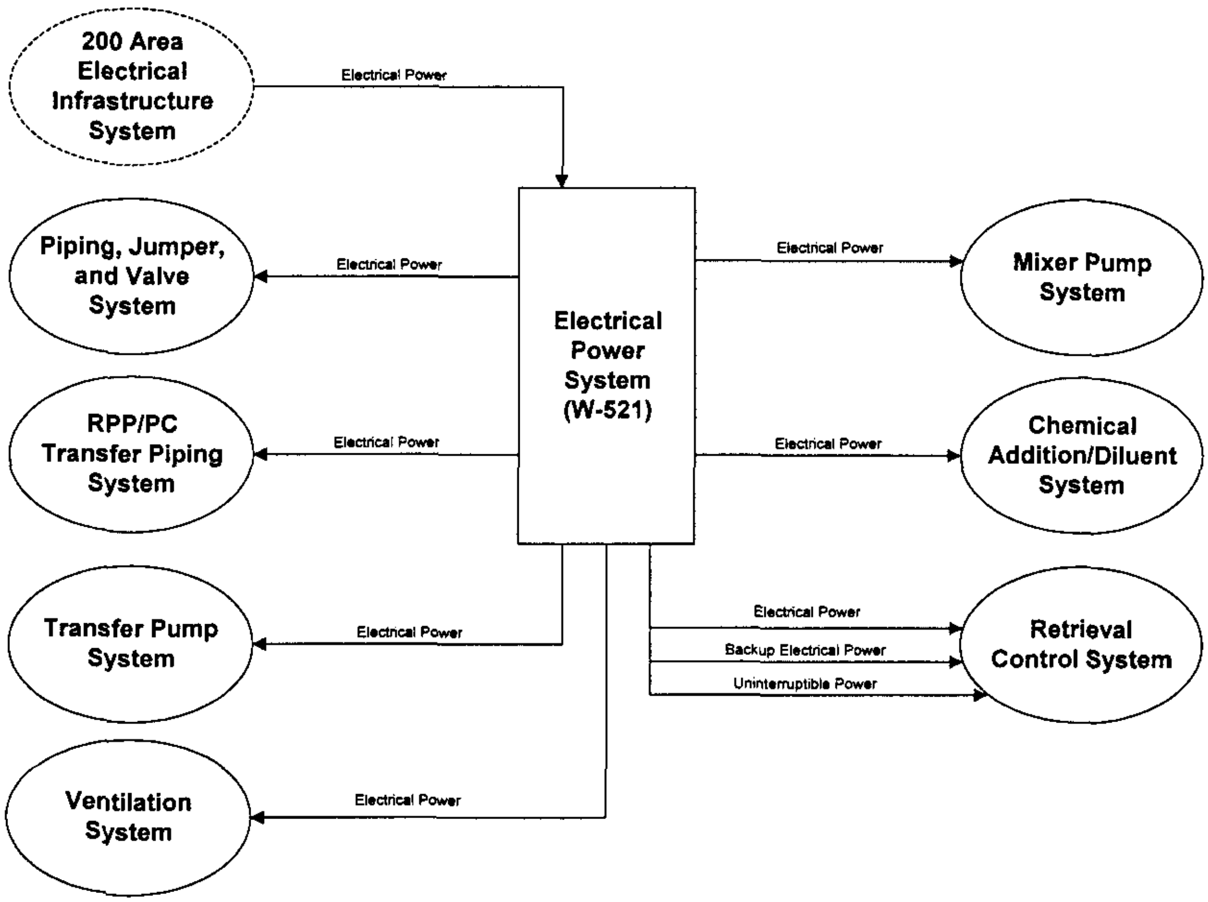


Figure 3-1. Electrical Power System Interfaces

3.1.3.1.1 Electrical Interfaces with the Raw Water System/Chemical Addition/Diluent System

a. **Requirement:** Electrical power is needed to operate valves and pumps, provide local control and monitoring capabilities and provide protection of the electrical water utility and the chemical addition/diluent system components.

Basis: This requirement is to support requirements in W-521-SDD-01, Diluent and Flush System Design Description.

3.1.3.1.2 Electrical Interfaces with the Central Plateau Electrical System

a. **Requirement:** The Electrical Power System shall obtain electricity from the Central Plateau Electrical System and distribute it throughout the DST system.

Basis: These requirements are per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.1.2.1.1.a.

3.1.3.1.3 Electrical Interfaces with the Mixer Pump/Transfer Pump Systems

a. **Requirement:** The electrical distribution system shall provide electric power to the Mixer Pump and Transfer Pump Systems. Electrical power is needed to operate mixer pump and transfer pump motors, provide local control and monitoring capabilities and provide protection for the electrical mixer pump and transfer pump system components.

Basis: This requirement is to support requirements in W-521-SDD-03, Mixer Pump System Design Description, and W-521-SDD-07, Transfer Pump System Design Description.

3.1.3.1.4 Electrical Interfaces with the Retrieval and Control System

a. **Requirement:** The electrical distribution system shall provide electric power to the retrieval and control system. Electrical power is needed to monitor and control DST Farm components and the overall WFD process. The DST Monitoring and Retrieval Control System monitors and controls safety-class equipment (i.e., ventilation system), therefore the respective monitoring and controls may require an UPS power supply or a fail safe designed system.

Basis: This requirement is to support requirements in W-521-SDD-04, Retrieval Control System Design Description.

3.1.3.2 Raw Water System Interfaces

Interfaces with the Raw Water System are illustrated in Figure 3-2.

3.1.3.2.1 Raw Water Interfaces with the Central Plateau Raw Water System

a. **Requirement:** The raw water system shall be designed to operate within the values in Table 3-2 of HNF-4157.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.1.2.1.2.a.

3.1.3.2.2 Raw Water Interfaces with the Instrumentation and Control System

a. **Requirement:** The DST Monitoring and Retrieval Control System shall provide the ability to display needed process data, to control process operations, and to provide historical operational data.

Basis: *This requirement is to support requirements in W-521-SDD-04, Retrieval Control System Design Description.*

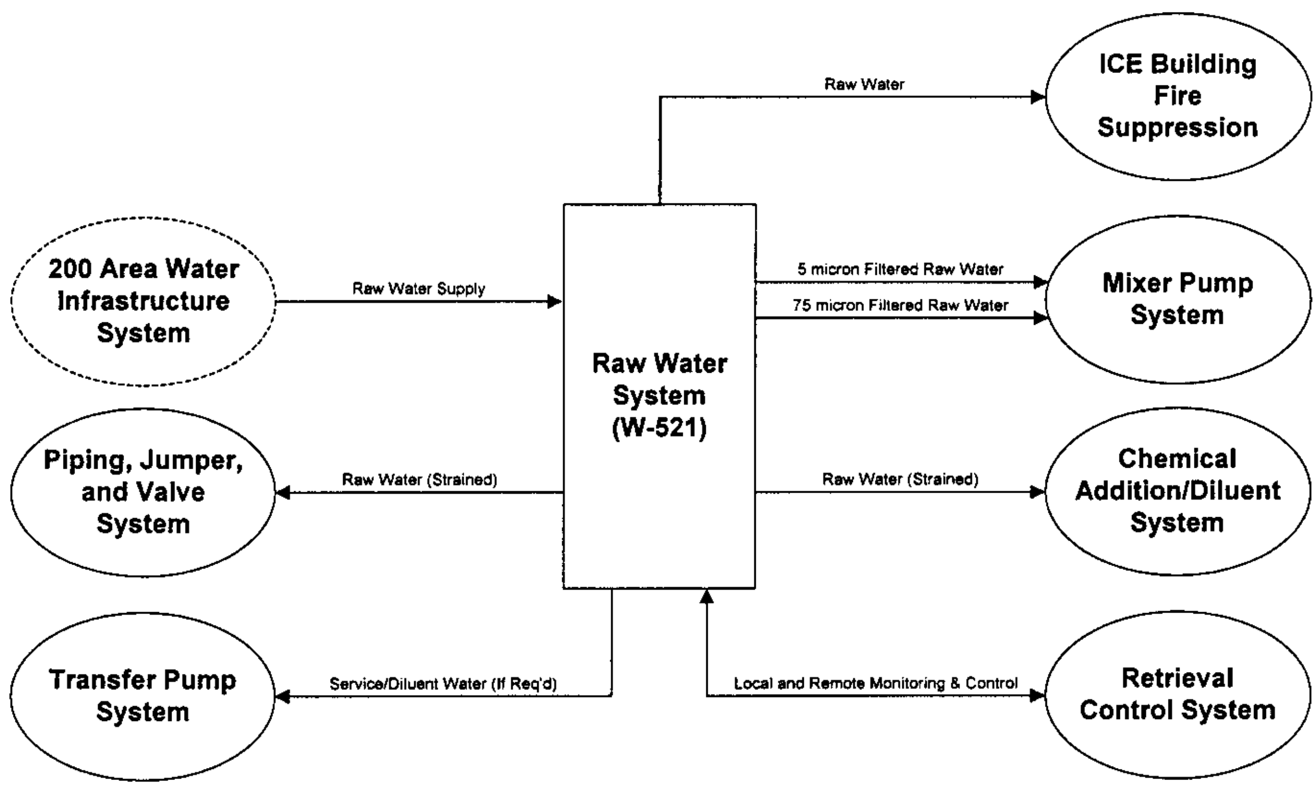


Figure 3-2. Raw Water System Interfaces

3.1.3.2.3 Raw Water Interfaces with the Piping, Jumper, and Valve System

a. **Requirement:** The Piping, Jumper and Valve System shall be equipped with a pressure detection system on lines physically connected to an active waste transfer pump to prevent contamination of the service water system via backflow of waste into the service water line.

Basis: *This requirement is to support requirements in W-521-SDD-05, Piping, Jumper, and Valve System Design Description.*

3.1.3.3 Potable Water System Interfaces

Interfaces with the Potable Water System are detailed in Figure 3-3.

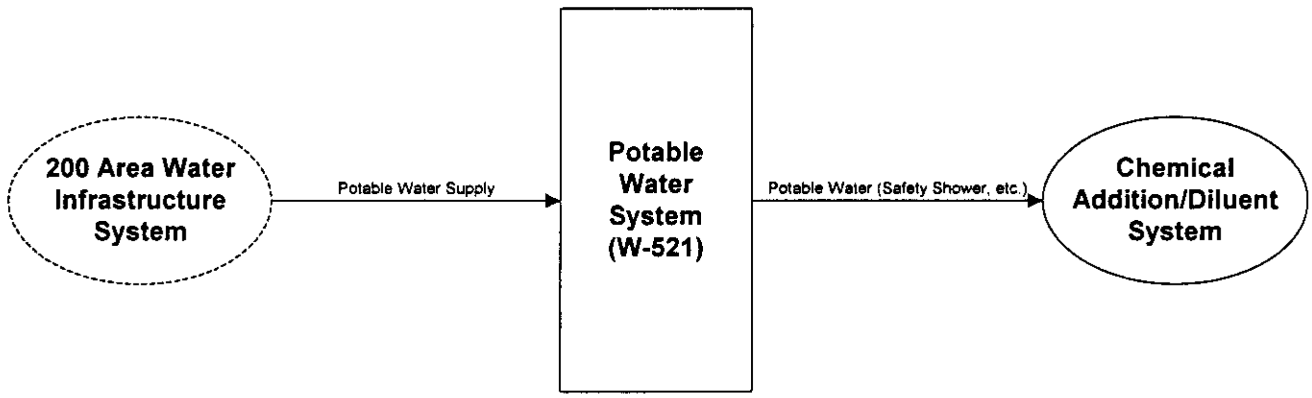


Figure 3-3. Potable Water System Interfaces

3.1.3.3.1 Potable Raw Water Interfaces with the Central Plateau Potable Water System

a. **Requirement:** The potable water system shall be designed to operate within the values in Table 3-3 of HNF-4157.

   Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.1.2.1.3.a.*

3.1.4 Codes, Standards, and Regulations

Design requirements applicable to the Electrical/Water Utilities System come from government and non-government source documents and various codes and standards. Each document (of the exact revision identified) in this section is invoked by one or more requirements of this specification and represents a part of this specification to the extent specified.

3.1.4.1 Government Documents

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State constitute a part of this specification to the extent specified herein. The regulatory documents that form a part of this specification are listed in Table 3-1.

Table 3-1. Government Documents

Document Number	Title
DOE 5820.2A, 1988	*Radioactive Waste Management,* U.S. Department of Energy, Washington, D.C.
DOE 6430.1A, 1989	*General Design Criteria,* U.S. Department of Energy, Washington, D.C.
DOE/RL-96-109, Rev. 2, 1999	*Hanford Site Radiological Control Manual,* U.S. Department of Energy-Richland Operations Office, Richland, Washington.
RCRA, 1976	*Resource Conservation and Recovery Act of 1976, 42 USC 6901.*
10 CFR 835	Occupational Radiation Protection, Code of Federal Regulation, dated 11/98, Washington, D.C.

3.1.4.2 Non-Government Documents

National codes, standards, and the Hanford Site documents listed in Table 3-2 constitute a part of this specification to the extent specified herein. The RPP-PROs implement federal and state regulations and DOE Orders. In addition, it should be noted that some requirements are based on the existing Authorization Basis documents (e.g., HNF-SD-WM-SAR-067, HNF-SD-WM-TSR-006, etc.). The Authorization Basis requirements may be changed, if necessary, after analysis and justification of the resulting risk being incurred have been outlined in a final safety analysis report (FSAR) amendment, and approval is obtained from the DOE Office of River Protection (ORP). In addition, the list of procedures is not intended to be complete, but rather to identify key ones which, when implemented, will support successful completion of design activities. Specific other procedures/documents are referenced throughout the sections of this document.

3.1.5 Operability

The Electrical/Water Utility System does not serve any safety function and there are no unique operability requirements placed on these systems.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

There are no identified requirements relating to radiation and other hazards for the Electrical/Water Utilities System.

Table 3-2. Non-Government Documents

Document Number	Title
ASME NQA-1, 1997, Subpart 2.2, Section 3.2	*Nuclear Quality Assurance Requirements for Nuclear Applications*, American Society of Mechanical Engineers, New York, New York.
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP -PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP -PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP -PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP -PRO-701, Rev. 0, 1999	*Safety Analysis Process – Existing Facility.*
RPP -PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP -PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP -PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*
RPP -PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP -PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP -PRO-1819, Rev. 0, 1999	*PHMC Engineering Requirements.*
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2937, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2962, 1998	*A List of Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC) Requirements*, Numatec Hanford Corporation for Fluor Daniel Northwest for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 1A, 1999	*RPP Administration, "Tank Farm Operations Equipment Labeling,"* Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-MP-599, Rev. 3, 1999	*Project Hanford Quality Assurance Program Description*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TRD-007, Rev. E Draft, 1998	*System Specification for the DST System*, COGEMA Engineering for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TSR-006, Rev. 1, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
NACE RP 0169-96, 1996	*Control of External Corrosion Engineers*, Houston, Texas.
WHC-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
WHC-SD-WM-HSP-002, Rev. 3B, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-5183, Rev. 0, 1999	Tank Farms Radiological Control Manual, Fluor Daniel Hanford, Richland, Washington.

3.2.2 ALARA

a. **Requirement**: The Electrical/Water Utilities System shall be designed to keep personnel exposures As Low As Reasonable Achievable (ALARA) in accordance with RPP-PRO-1621 and RPP-PRO-1622.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.1.a.

3.2.3 Nuclear Criticality Safety – N/A

3.2.4 Industrial Hazards

a. **Requirement**: The Electrical/Water Utilities System shall incorporate design features that comply with the requirements of WHC-SD-WM-HSP-002.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.1.b.

b. **Requirement**: The Electrical Power Subsystem distribution system shall be designed such that power can be locked out in compliance with "Lock and Tag Program," HNF-IP-0842, Volume II, Section 4.9.1, Rev. 5e.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.1.c.

3.2.5 Operating Environment and Natural Phenomena

a. **Requirement**: The Electrical/Water Utilities System shall be designed for the natural environmental conditions specified in *Natural Phenomena Hazards, Hanford Site Washington*, HNF-SD-GN-ER-501.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.5.1.a.

b. **Requirement**: The system shall be designed to withstand the natural phenomena hazards as specified in *Engineering Design and Evaluation*, RPP-PRO-097.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.5.1.b.

c. **Requirement**: The Utilities Subsystems shall comply with flexibility and expansion requirements of General Design Criteria, DOE Order 6430.1A, 0110-3.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.7.a.*

d. **Requirement:** All equipment installed in areas in and around the tank that are subject to ignition controls shall be designed to meet the requirements of HNF-SD-WM-TSR-006, Section 5.10, "Ignition Controls." Areas requiring controls are delineated in HNF-SD-WM-SAR-067, Appendix K. The Flammable Gas Equipment Advisory Board shall be consulted whenever the application or interpretation of the requirements is unclear.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.3.b.*

3.2.6 Human Interface Requirements

a. **Requirement:** System design shall comply with DOE Order 6430.1A, Section 1300.12, "Human Factors Engineering."

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.7.a.*

b. **Requirement:** Control devices shall be designed in accordance with NUREG 0700, Section 6.4 and MIL-STD-1472D, Section 5.4.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.7.b.*

3.2.7 Specific Commitments

No specific commitments have been identified.

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

a. **Requirement:** All of the DST Utility Subsystems shall have a design life of 35 years.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.3.b.*

b. **Requirement:** All general service Electrical/Water Utilities System structures shall meet the applicable design, test, and construction requirements contained in ACI 318.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.1.a.*

c. **Requirement**: The equipment used for installation and maintenance shall not exceed the DST dome loading constraints given in HNF-IP-1266.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.2.c.

3.3.2 Mechanical and Materials

a. **Requirement**: All valves shall meet the applicable design and fabrication requirements contained in ASME B16.34.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.3.a.

b. **Requirement**: All water piping shall be designed in accordance with the Uniform Plumbing Code (UPC).

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.3.c ,and 3.3.1.3.h, as modified by engineering judgment

c. **Requirement**: Extension of existing Central Plateau Water System distribution headers required to obtain additional raw/potable water capacity to a given tank farm shall be designed and installed in accordance with the *Water System Design Manual*, DOH 331-123; "State Building Code," RCW 19.27; "Water System Operations," WAC-246-290; and *Criteria for Sewage Works Design.*

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.3.d.

d. **Requirement**: The Electrical/Water Utilities System shall incorporate corrosion prevention and control features in accordance with WAC 173-303-640(3); DOE Order 6430.1A, Section 0262; and DOE Order 5820.2A, Chapter 1, Sec. 3.b (2)(g).

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.2.a.

e. **Requirement**: Underground piping shall be protected from external chemical and electrolytic attacks due to soil conditions.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.2.d.

3.3.3 Chemical and Process

There are no chemical or process requirements specific to the Electrical/Water Utilities System.

3.3.4 Electrical Power

a. **Requirement**: Indoor electrical equipment enclosures shall be as a minimum NEMA Type 12.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.a. Note: the Design Authority is processing paperwork to resolve issue. Electrical enclosures and junction boxes of the proper NEMA rating shall be utilized.

b. **Requirement**: Adverse effects of voltage level variations, transients, and frequency variations (i.e., power quality) on equipment operation shall be minimized and sensitive electrical equipment, such as monitoring and control and data processing equipment, shall be isolated as needed for power quality protection.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.b.

c. **Requirement**: The electrical distribution system shall comply with NFPA 70.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.c.

d. **Requirement**: System protection shall comply with the latest versions of IEEE 242.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.d.

e. **Requirement**: Switchboards, MCCs, and power panels shall comply with the latest version of IEEE C37 Series.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.e.

f. **Requirement**: Exterior lighting systems shall use time clocks and/or photocells to provide illumination only when needed.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.f.

g. **Requirement**: Interior lighting shall make use of florescent and/or high-intensity discharge lighting.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.g.

h. **Requirement:** Lightning Protection Systems, if required, shall be designed in accordance with the guidelines provided in NFPA 780.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.2.e.*

i. **Requirement:** Outdoor electrical equipment enclosures shall be NEMA Type 4 or 4X.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.h. Note: the Design Authority is processing paperwork to resolve issue. Electrical enclosures and junction boxes of the proper NEMA rating shall be utilized.*

j. **Requirement:** Electrical calculations shall be provided or existing calculations shall be revised when any additional to the electrical system load is required.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.i.*

k. **Requirement:** Any modifications to the site electrical utilities distribution system, including the 13.8 kV– 480 V transformers, shall conform to the ANSI C2.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.j.*

l. **Requirement:** New or upgraded Electrical Utility transformers shall be sized and installed in accordance with IEEE C57.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.k.*

m. **Requirement:** Electrical equipment, identified as Electrical Utilities-owned, shall be designed in accordance with Electrical Utilities Design Authority project design criteria.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.l.*

n. **Requirement:** Electrical design and installation shall comply with the electrical safety installations requirements outlined in RPP-PRO-089, Rev. 0.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.1.2.m.*

3.3.5 Instrumentation and Control

a. **Requirement:** The system shall comply with electromagnetic radiation emission requirements set forth in HNF-2962.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.2.

b. **Requirement:** Control equipment shall comply with NEMA ICS standards and *UL Standard for Safety for Industrial Control Equipment*, UL 508.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 4.1.2.b. Note: the Design Authority is processing paperwork to resolve issue. Electrical enclosures and junction boxes of the proper NEMA rating shall be utilized.

3.3.6 Computer Hardware and Software

No computer hardware and software requirements are identified for the Electrical/Water Utilities System.

3.3.7 Fire Protection

a. **Requirement:** Required fire protection piping shall be in accordance with NFPA 24.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.1.d.

3.4 Testing And Maintenance Requirements

3.4.1 Testability

Testability requirements are identified in section 3.4.3 and 4.3.4.1.

3.4.2 TSR Required Surveillance

a. **Requirement:** Water pressure detection systems that are physically connected to an active waste transfer pump not under administrative lock shall comply with HNF-SD-WM-TSR-006, LCO 3.1.2.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.6.3.c.

3.4.3 Non-TSR Inspections and Testing

a. **Requirement:** Electrical materials and equipment shall be qualification tested unless they are Underwriters Laboratories (UL) listed or FM approved, with label attached, and for the purpose intended, whenever such products are available. Where no UL or FM listed products of the type are available, testing, and certification by another nationally recognized testing laboratory might be acceptable as long as the design agent documents acceptance of the testing organization.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 4.1.2.a.*

3.4.4 Maintenance

a. **Requirement:** The Electrical Subsystem distribution should be designed such that required preventive maintenance or calibration can be performed outside of the tank farms.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.4.a.*

b. **Requirement:** The Raw Water Subsystem distribution shall be designed such that required testing of raw water backflow preventers can be performed outside of the tank farms.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.4.b.*

c. **Requirements:** The Raw Water Subsystem shall provide shut-off valves to isolate equipment valves, or appurtenances for ease of maintenance.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.4.c.*

d. **Requirement:** Below-grade components either shall not require preventive maintenance over their design life or shall be designed for preventive or corrective maintenance to be performed without excavation.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.5.1.a.*

e. **Requirement:** Backflow-preventers shall be easily accessible for annual testing and acceptance by a state-certified inspector.

Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.5.1.c.*

3.5 Other Requirements

3.5.1 Security and Special Nuclear Material Protection

There are no security or SNM protection requirements identified for the Electrical/Water Utilities System.

3.5.2 Special Installation Requirements

a. **Requirement:** Underground utility lines such as sanitary sewer, water, and air shall not be placed under existing or proposed pavements, except when crossing such pavements or when adequate space is not available. Utility lines shall be placed between backslope of road ditch and building, or back of curb.

   Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.2.a.*

b. **Requirement:** Water mains shall not be installed in the same trench with sewer lines. Where water mains and sewer lines are installed parallel to roadways, they shall, if practicable, be located on opposite sides of roadways.

   Basis: *These requirements are per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.2.b.*

c. **Requirement:** Where feasible, sewer lines shall not be routed within 10 ft (3 m) of potable water lines. Where potable water lines must cross sewer lines, water lines shall pass 2 ft (0.6 m) above the sewer line.

   Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.2.c.*

3.5.3 Reliability, Availability, and Preferred Failure Modes

a. **Requirement:** The 480Y/277 VAC electrical distribution system reliability shall comply with *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems*, IEEE 493, to ensure a continuous power supply to systems and equipment designated as critical.

   Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.3.a.*

b. **Requirement:** The Electrical/Water Utilities Systems shall have a design life of 35 years.

   Basis: *This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.2.3.b.*

3.5.4 Quality Assurance

a. **Requirement:** Quality assurance for the Electrical/Water Utilities System shall be performed in accordance with IP-0842, Volume XI, Section 1.0.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 4.2.

b. **Requirement:** The system design shall be verified to RPP-PRO-1819, Section 2.9.1.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 4.0.

3.5.5 Miscellaneous

a. **Requirement:** The Utilities Subsystems shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in *RPP Administration*, "Tank Farm Operations Equipment Labeling," HNF-IP-0842, Volume II, Section 6.1.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.3.a.

b. **Requirement:** To maintain control over the supply of electricity, the first downstream 480 V disconnect switch from the serving 13.8 kV– 480 V transformer shall be labeled with the Site electrical utilities standardized labeling program as specified in KEH-SD-LL-RD-004 and WHC-IP-0558, DI-52660-3.01.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.3.3.b.

c. **Requirement:** Records, documents, and drawing control pertinent to design functions shall be in accordance with RPP-PRO-222 and RPP-PRO-224. Engineering document development shall be in accordance with RPP-PRO-709.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.4.a.

d. **Requirement:** Electrical/Water Utilities System structures, systems, and components (SSCs) shall be incorporated into the master equipment list in accordance with HNF-IP-0842, Volume II, Section 6.1.

Basis: This requirement is per HNF-4157, Double-Shell Tank Utilities Specification, Rev. 0, Section 3.4.b.

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

4.1.1 Description of System, Subsystems, and Major Components

The sections presented below provide a brief description of the major components of the Electrical/Water Utilities System.

4.1.1.1 Electrical Power Distribution System

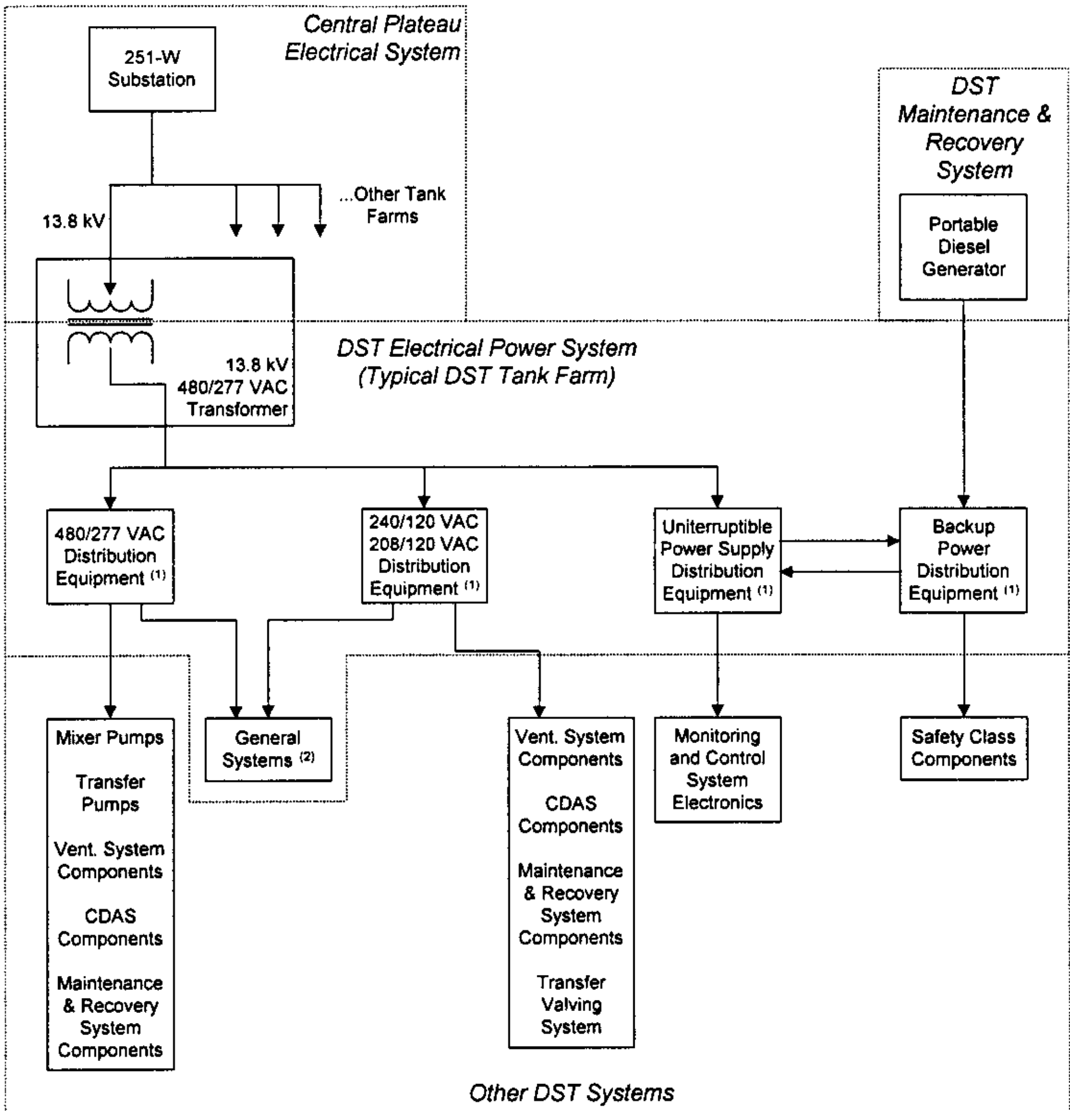
The normal electrical power distribution system is comprised of the 13.8 kV, 480Y/277 V, 208Y/120 V, and 240/120 V systems and equipment required for the distribution and transformation of electrical power. The normal electrical system supports all of the operational activities conducted by the tank farm facilities. This system is a radial type feed from a Central Plateau 13.8 kV substation via overhead lines, which distribute 13.8 kV power to each DST Farm. Each DST Farm has a 13.8 kV- 480Y/277 V service transformer, and a main 480Y/277 V switchboard to distribute power within each tank farm. The 480Y/277 V switchboard supplies power to pumps, 480 V equipment, 480 V-208Y/120 V and 480 V-240/120 V Transformers to supply power to instrumentation, lighting and equipment requiring 208Y/120 V or 240/120 V power. Figure 4-1 shows how this distribution is accomplished.

The electrical power distribution system includes an extension of a 13.8 kV overhead primary distribution line to a power pole with fused cutouts and lightning arresters. The line is converted to an underground cable feed for the oil-filled, pad-mounted transformers to convert the 13.8 kV to 480Y/277 V power. The transformer neutral is bonded to the ground system that is comprised of ground rods around the transformer to create the 480 V system neutral. The service entrance feeder cables to the DST Farm switchboard enter through an underground duct bank.

The DST Farm switchboards are located in new Instrument Control Equipment (ICE) buildings or existing electrical buildings at each DST Farm. The 480Y/277 V switchboard is rated, three-phase; four-wire, and comprised of a free-standing, metal-enclosed assembly of power busses, neutral and ground buses, power and molded case circuit breakers, and metering equipment.

The DST Farm switchboard distributes 480 V, three-phase power through circuit breakers to the DST Farm loads, MCCs, VFDs for mixer and transfer pump and transformers to reduce the voltage to 208Y/120 V and 240/120 V for instrumentation and other equipment requiring 208Y/120 V or 240/120 V.

The DST Farm ground system includes bonded neutral and ground electrode connections at both the 480Y/277 V pad mounted transformer and the 480Y/277 V DST Farm switchboard. Bonded neutral and grounding electrode connections are provided at each separately derived system neutral (i.e., each 208Y/120 V Transformer). An insulated equipment ground conductor is run with each power feeder in conduit. Exothermic welded connections are used where bolted or compression type connections are not accessible.



Notes:
(1) Distribution Equipment includes MCCs, CBPs, transformers, switches, and related equipment.
(2) General Systems include security, lighting, convenience outlets, etc.

Figure 4-1. Typical One-Line Diagram of the Electrical Power Distribution System.

4.1.1.2 UPS Power

Equipment that requires guaranteed continuous power, or cannot sustain functions through the momentary power loss that occurs when an alternative power source comes on line and picks up the load shall be provided with an uninterruptible power supply (UPS). Any UPS required will be included as part of the RCS equipment cabinets.

4.1.1.3 Raw/Potable Water

The Central Plateau raw water distribution infrastructure delivers unfiltered raw water and potable water to each DST farm service points. The DST Farm raw water system distributes strained-raw and filtered-raw water within each DST Farm complex. The DST Farm potable water system distributes potable water within each DST Farm complex to equipment such as safety showers. Figure 4-2 shows how this distribution is accomplished.

The DST Farm Raw Water Distribution system consists of piping, filters, service pits, and related components that distribute raw, strained and filtered water to DST Farm Complex utilization equipment. Strained raw water is supplied to provide makeup water to the Diluent/Flush System, to flush the Transfer Piping System, and to provide both filtered raw water distribution for various mixer pump components. The 75-micron filtered raw water distribution subsystem supplies raw water to the mixer pump sparge rings and to the 5-micron raw water distribution subsystem. The 5-micron filtered raw water supplies the mixer pump column fill and upper mechanical seal systems. Potable water is used in safety showers and eyewash stations located near the Diluent/Flush System components.

4.1.2 Boundaries and Interfaces

4.1.2.1 Electrical Power

The Central Plateau Electrical Power distribution infrastructure delivers medium-voltage 13.8 kV services to the DST Farms. This electrical distribution infrastructure receives electrical power from the 251-W substation, located north of the 200 Areas, and distributes it to Central Plateau facilities, including the DST farms. The 13.8 kV power is generally distributed over several overhead distribution lines within the 200 Area. The 13.8 kV distribution lines that deliver power to the DST farms are considered normal power. The interface points between the Central Plateau electrical distribution infrastructure and the DST Farm electrical distribution system are typically on the secondary side of the DST Farm service transformers.

The DST Farm electrical power system consists primarily of 480Y/277 V switchboards located adjacent to the DST Farm complex. The 480Y/277 V switchboards distribute power to motor control centers (MCCs) and power panels for DST Farm Complex equipment. The electrical distribution system also distributes power to transformers that step down the 480 V power to the 240/120 V and 208Y/120 V power panels for DST equipment requiring these lower voltages. The electrical distribution system consists of MCCs, transformers, switches, and related equipment. The interface points between the DST Farm electrical distribution system and the other DST systems is generally at the secondary side of the feeder breaker providing electrical power to the equipment. Local equipment controls are considered part of the equipment and are not part of the electrical power system.

New VFDs will be installed to power the new mixer pumps and transfer pumps installed in the AW-, AY, and SY Tank Farms.

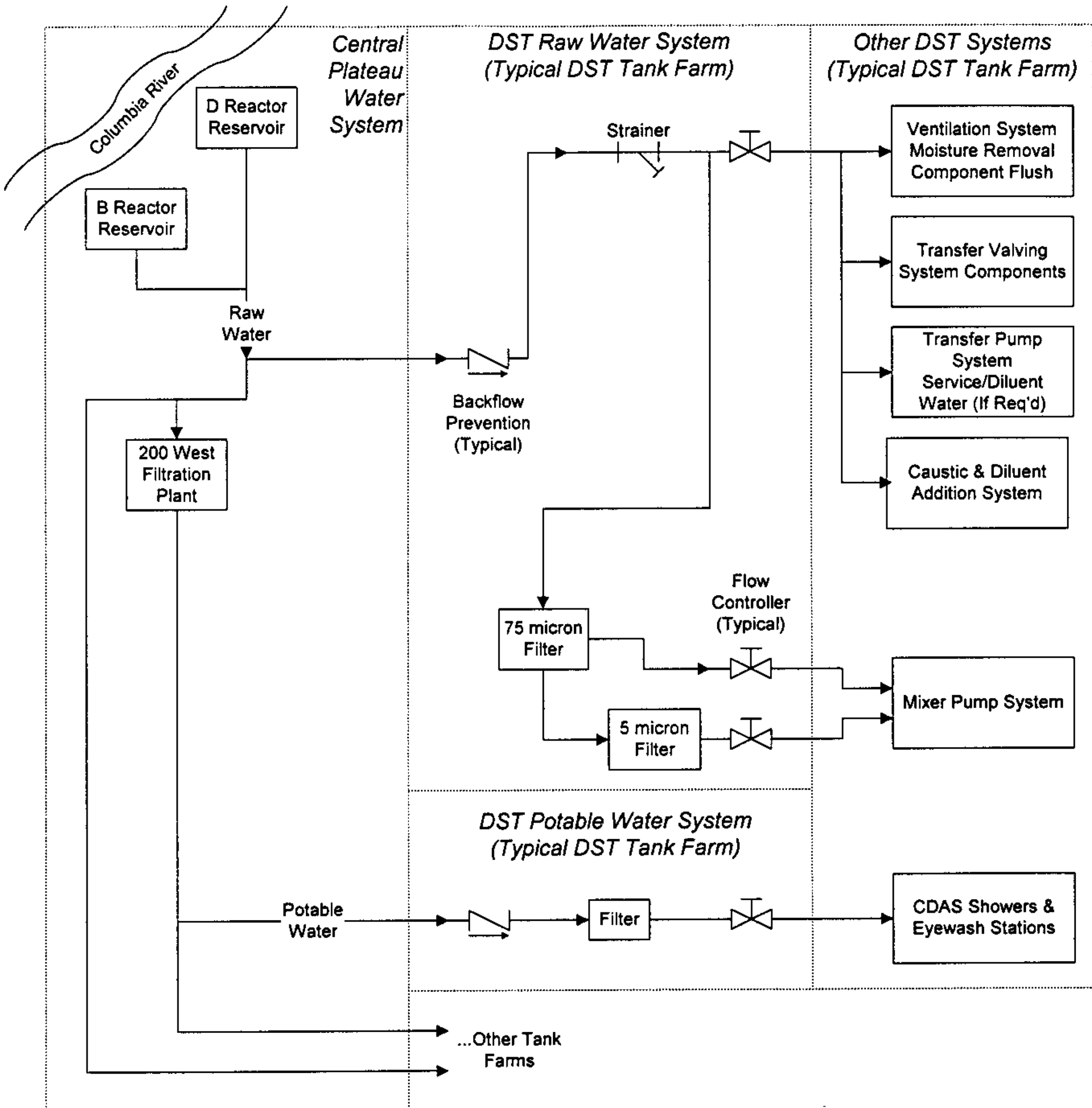


Figure 4-2. Schematic of Raw/Potable Water Systems.

4.1.2.2 Raw/Potable Water

The Central Plateau Water System delivers raw and potable water to the DST Farms. The raw water distribution infrastructure receives raw water from two reservoirs located near the 100B and 100D reactor facilities. The water is distributed from these reservoirs through an underground main piping system and then supplied to each tank farm via a branch feeder. The raw water is also supplied to a filtration plant in the 200 West area and converted to potable water. This potable water is then distributed to tank farms within the 200 West and 200 East areas. The raw/potable water systems typically interface with the DST raw/potable water systems at a point five feet outside the fence of the tank farm. Backflow prevention is the responsibility of the DST Farm.

4.1.3 Physical Location and Layout

4.1.3.1 Electrical Power Equipment Location and Layout.

All equipment enclosures and raceway systems used for electrical components and wiring distribution are environmentally suitable for the locations in which they are placed and the functions they support. Each DST Farm or physical area is considered individually in determining its classification, depending on the properties and quantities of the potential radioactive contamination, vapors, liquids, gases, chemicals, combustible dusts, or fibers that may be present. Special precautions are designed into the system for all areas with corrosive or hazardous atmosphere. All equipment including sensing devices required to be in the vapor space regions (ex-tank intrusive and dome intrusive), shall be designed in accordance with HNF-SD-WM-TSR-006, Section 5.10, Ignition Source Control Sets #1 and #2.

The following sections summarize the layout of important equipment for each of the subsystems of the electrical system.

4.1.3.1.1 AP-Tank Farm

The existing main switchboard is located in an ICE building, and is powered by an underground feed from an existing 1000 kVA transformer. Project W-211 will install new mixer or transfer pumps. The AP-Tank Farm will only require 208Y/120 V power for the Project W-521 equipment associated with the transfer piping.

4.1.3.1.2 AY-Tank Farm

Project W-521 will provide a new 1000 kVA transformer, switchboard, and VFDs in a new ICE building to power the two new mixer pumps and a new transfer pump in each tank for AY-101 and AY-102. The existing AY Tank Farm MCC (EDS-MCC-601) in the existing AY-801 Building will be powered from the new switchboard.

4.1.3.1.3 AW-Tank Farm

The new main switchboard will be located in a new ICE building, and powered by an underground feed from a new 2000 kVA transformer. Two new mixer pumps in each tank for AW-101, AW-103 and AW-104 and new transfer pumps for AW-101, AW-103 and AW-104 will be fed from new VFDs and transfer switches. Power will be provided for a new caustic & diluent system pump and associated electrical water heaters. The existing AW-Tank Farm MCC (EDS-MCC-001) in the existing 271-AW building will be powered from the new switchboard.

4.1.3.1.4 SY-Tank Farm

The existing main switchboard is located in building 252-S which will feed the new ICE building. The existing transformers will be changed to (2) 1500 kVA transformers by Project W-521 to support the new loads in the SY-Tank Farms. A new switchboard will be located in the ICE building to feed the VFDs for the two mixer pumps for SY-101, SY-102, and SY-103 and transfer pumps for SY-101, SY-102, and SY-103, and 208Y/120 V equipment within the SY-Tank Farm.

4.1.3.2 Raw/Potable Water Equipment Location and Layout

Raw water and potable water will be supplied to the new Diluent and Flush System in the SY and AW-Tank Farms. In addition, filtered raw water will be distributed to the mixer pumps in the AY-, AW-, and SY-Tank Farms.

4.1.4 Principles of Operation

No special operational features are required.

4.1.5 System Reliability Features

System reliability is as specified in the procurement documentation.

4.1.6 System Control Features

System control features for the Electrical/Water Utilities System are described in the SDD for the DST Monitoring and Retrieval Control System.

4.1.6.1 System Monitoring

System monitoring will be defined as the design progresses.

4.1.6.2 Control Capability and Locations

Control capability and locations will be defined as the design progresses.

4.1.6.3 Automatic and Manual Actions

These controls will be defined as the design progresses.

4.1.6.4 Setpoints and Ranges

Setpoints and ranges will be defined as the design progresses.

4.1.6.5 Interlocks, Bypasses and Permissives

These controls will be defined as the design progresses.

4.2 Operations

4.2.1 Initial Configurations (Pre-startup)

4.2.1.1 Electrical Power

There are no pre-start configurations for the electrical power systems.

4.2.1.2 Raw/Potable Water

There are no pre-start configurations for the raw/potable water systems.

4.2.2 System Startup

Startup testing and alignment requirements will be specified in future test specifications.

4.2.3 Normal Operations

4.2.3.1 Electrical Power

During normal operation, the power distribution system interfaces with all systems that require power, and the grounding required for operation. Should a fault occur, circuit protection attempts to prevent any damage to the electrical system and minimize damage to faulty equipment. Lighting provides a safe working environment. Operational procedures will be developed identifying all operator actions.

4.2.3.2 Raw/Potable Water

Any special requirements will be specified as design progresses.

4.2.4 Off-Normal Operations

4.2.4.1 Electrical Power

In the event of power failure, integral battery backup powered lights provide adequate temporary lighting in buildings for a safe environment while exiting. Operational procedures will be developed identifying all operator actions for other systems.

4.2.4.2 Raw/Potable Water

There are no off-normal operations identified for the Raw/Potable Water systems.

4.2.5 System Shutdown

4.2.5.1 Electrical Power

There are no system shutdown operations identified for the Electrical Power System.

4.2.5.2 Raw/Potable Water

There are no system shutdown operations identified for the Raw/Potable Water systems.

4.2.6 Safety Management Programs and Administrative Controls

Administrative controls and procedures will be developed consistent with the ORP integrated safety management plan.

4.3 Testing and Maintenance

4.3.1 Temporary Configurations

There are no temporary configurations identified for the Electrical/Water Utilities System.

4.3.2 TSR Required Surveillances

There are no TSR required surveillances.

4.3.3 Non-TSR Inspections, and Testing

4.3.3.1 Electrical Power

Remote ground resistance tests will be conducted to measure the effective resistance of the ground electrode system. Testing is required for all conductors for continuity to ground.

The 13.8 kV conductor connecting the existing utility located adjacent to the DST facilities site will be tested in accordance with construction specifications.

After installation and prior to energizing, Site Utilities will perform test on the 13.8 kV transformers and DC overpotential (Hi-Pot) tests on the 13.8 kV cable to verify acceptability of installation.

DST Farm installations will be tested for insulation resistance after all wiring is complete and ready for attachment to fixtures and equipment (transformers, motors, switchboard, VFDs, motor control centers (MCC).

If any of the tests yield defective wiring or parts, the defective equipment is replaced and all applicable tests rerun. Other pre-startup activities/tests will be identified in the test specification.

Only routine functions are normally recommended or required after initial testing and energizing. Routine functions include the following:

- Periodic visual inspection of exposed cable and bolted connections of the ground system.
- Periodic inspection of the cathodic protection system equipment and connections.
- Visual inspection of the lighting system. Failed lamps are replaced, as necessary, to maintain lighting at a safe level.

In addition to the visual inspections, a standardized test program for the major components is to be instituted as identified in the test specification. Lockout and tagout procedures are utilized to ensure that personnel work on de-energized circuits only.

4.3.3.2 Raw/Potable Water

No specific non-TSR inspections and testing for the raw/potable water systems have been identified.

4.3.3.3 Maintenance

4.3.3.3.1 Post Maintenance Testing

No specific post maintenance testing activities for the Electrical/Water Utilities System have been identified.

MIXER PUMP SYSTEM DESIGN DESCRIPTION

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Task 00008
Report W-521-SDD-03
Revision 2

September 2000

Prepared by: Stephen D. Riesenweber

Approved by: RLFritz
Robert L. Fritz

Date: 9-29-00

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Tables

Acronyms

ACD	Advanced Conceptual Design
ALARA	As Low As Reasonably Achievable
ALCs	Air Lift Circulators
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
DBA	Design Basis Accident
DOE	U.S. Department of Energy
DST	Double-Shell Tank
ECR	Effective Cleaning Radius
GRE	Gas Release Event
HLW	High Level Waste
ICE	Instrumentation, Control and Electrical
LAW	Low Activity Waste
NEMA	National Electrical Manufacturers Association
NPSH	Net Positive Suction Head
O&M	Operations and Maintenance
RPP	River Protection Project
SC	Safety Class
SDD	System Design Description
SNM	Special Nuclear Material
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To be determined
TBR	To be refined
TSR	Technical Safety Requirements
UL	Underwriters Laboratories
VFD	Variable Frequency Drive
WFD	Waste Feed Delivery
WFDS	Waste Feed Delivery System
WTF	Waste Treatment Facility

1.0 INTRODUCTION

This System Design Description (SDD) identifies performance requirements, defines bases, and provides references to requisite codes and standards for the Waste Feed Delivery System (WFDS) Project W-521 double-shell tank (DST) Mixer Pump System. This revision incorporated requirements as specified in HNF-4164, Rev. 0, *Double-Shell Tank Mixer Pump Subsystem Specification.*

1.1 System Identification

The Mixer Pump Systems provides motive force to 1) mobilize settled waste, and 2) maintain a waste form suitable for transfer and treatment, and consists of the five major components shown below.

- Mixer Pump,
- Pump Motor,
- Pump Turntable,
- Pump Support, and
- Vertical Indexing System.

The scope of this SDD is limited to Mixer Pump Systems to be installed in waste tanks within the scope of WFDS Project W-521. Tanks within the scope of WFDS Project W-521 that will require mixer pumps are AW-101, AW-103, AW-104, AY-101, AY-102, SY-101, SY-102, and SY-103.

1.2 Limitations

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary, or highly conceptual in nature. This SDD will be a living document throughout the design phases of W-521, and will become more detailed as the design progresses. Requirements were taken from the *Double-Shell Tank Mixer Pump Subsystem Specification*, HNF-4164, Rev. 0. The previous revision was based on the Draft Level 2 Specifications.

1.3 Ownership

This SDD is owned by the Project Engineer responsible for the Mixer Pump System.

1.4 Definitions/Glossary

General Service (GS) SSC – Structures, systems, or components (SSCs) not classified as either Safety Class or Safety Significant.

Manifold – Remotely installed rigid piping system inside a pit that transfers waste and flush water between nozzles.

Mix/Blend – The process of combining waste material from more than one tank.

Mobilize – The process of resuspending settled sludge from the bottom of a tank.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

  - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
  - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
  - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
  - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
  - Two Safety – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

  (**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

RPP Design Authority – A person qualified in the practice of engineering with four years demonstrated job related experience including two years in their specific functional areas. For nuclear structures, systems, or components, they shall have at least one-year nuclear experience. The RPP Design Authorities for the facility and for the Project must have completed the RPP Design Authority Qualification Card and have an appointment letter approved by the RPP Chief Engineer.

Safety Class (SC) SSC – An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant (SS) SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall – Denotes a requirement.

Should – Denotes a recommendation. If a "should" requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

Suspend – The process of putting or keeping fluidized waste particles into a uniform suspension within the liquid phase of the waste

Tank Opening – Tank risers and pits with an open path to the tank.

To be determined (TBD) – A study and/or calculation needs to be performed in order to provide a sufficient technical basis for the requirement.

To be refined (TBR) – A "soft" basis for the requirement has been identified. However, a further study and/or calculation need to be performed in order to solidify the requirement's technical basis.

Transfer-Associated Structure – Pump pits, valve pits, diversion boxes, or cleanout boxes.

Waste Feed – Waste slurry to be transferred to the Waste Treatment Facility (WTF) containing a mixture of solids and liquids.

2.0 GENERAL OVERVIEW

2.1 System Functions

The overall mission of the Mixer Pump System is to reliably prepare the required quantities of tank waste for transfer to the treatment and immobilization facilities on schedule, within specifications, and in conformance with regulatory, safety, and contractual requirements. The system must perform the following functions to accomplish the overall mission of the Mixer Pump System:

- Mix waste for low activity waste (LAW) salt dissolution in source tanks,
- Monitor and control mixer pump operations for LAW salt dissolution,
- Mix waste in LAW staging tanks,
- Monitor and control mixer pump operations in LAW feed source and staging tanks,
- Mobilize and suspend solids in high level waste (HLW) feed source and staging tanks, and
- Monitor and control mixer pump operations in HLW feed source and staging tanks.

2.2 System Classification

The Mixer Pump System to be utilized for waste feed delivery is classified as "General Service".

2.3 Basic Operational Overview

The Mixer Pump System will be used for LAW and HLW waste preparation activities including, but not limited to, LAW salt dissolution, homogenization of LAW batches, mobilizing settled HLW solids, *mixing/blending* HLW batches, and HLW solids suspension.

- Waste preparation is performed prior to transferring LAW from the source tanks to the staging tanks. As part of waste preparation, mixer pumps will be utilized for LAW salt dissolution.

- Staging tanks are used to prepare LAW waste batches for transfer to the WTF. Mixer pumps are utilized for waste homogenization after waste batches are received at the LAW staging tanks.

- The HLW feed delivery strategy includes combining wastes from different source tanks into a single feed staging tank. After the wastes are received, they will be blended together to make up a homogeneous HLW feed. Mixing and/or blending of the waste will be performed by operation of mixer pumps.

- Solids suspension will be performed by operation of mixer pumps. The objective of waste suspension is to distribute the waste solids throughout the supernate to obtain uniform slurry that will meet both processing and transfer requirements.

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section identifies the general requirements for the Mixer Pump System and the bases for these requirements.

3.1.1 System Functional Requirements

a. **Requirement**: The Mixer Pump System shall agitate the LAW tank waste salt layer, mobilize insoluble solids in HLW tanks, and homogenize waste for sampling.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.1.*

b. **Requirement**: Precipitated salts are mobilized by mixer pump operation to facilitate the dissolution process. The mobilization process shall be controlled by monitoring mixer pump operation and process parameters, comparing data to process limits, and maintaining process parameters within limits.

Basis: *This requirement is per HNF-5146, Low-Level Waste Feed Process Control Strategy, Rev. 0, Section 4.2.2.*

c. **Requirement**: The Mixer Pump System shall be capable of mixing diluent with settled solids containing undissolved salts in LAW tanks such that adequate salt dissolution is achieved and the tank is homogenized.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.2.*

d. **Requirement**: The Mixer Pump System shall be capable of mobilizing and homogenizing settled solids in HLW tanks to suspend the solids in the waste slurry.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.3.*

e. **Requirement**: The Mixer Pump System shall provide instrumentation output to allow remote monitoring and control from a DST Monitoring and Retrieval Control System located outside the tank farm radiation zone.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.1.2.1.4.a.*

f. **Requirement**: Mixer pump operation shall be monitored to ensure proper operation and mechanical integrity of the pump, and limit impingement on other in-tank equipment.

Basis: *This requirement is per HNF-5146, Low-Level Waste Feed Process Control Strategy, Rev. 0, Section 6.2.2.*

g. **<u>Requirement</u>:** The Mixer Pump System shall accept and route externally supplied water/diluent to the pump cavity for flushing, to the pump suction area for waste dilution during startup/operation, for addition of bulk dilution water, for waste displacement below the pump during installation; and, depending on design, water to fill the column and pressurize mechanical seals. (Note: All of these connections shall be above grade and shall not tie to the Transfer Piping System. Water systems that are exposed to pump discharge pressure shall be protected to prevent potential backflow. Water connections must comply with requirements of HNF-SD-WM-TSR-006, Section 3.1.2, LCO 3.1.2.)

<u>Basis</u>: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.2.2.c and 3.2.2.g.

h. **<u>Requirement</u>:** To the extent practical, mixer pump designs shall be standardized to allow use in multiple tanks.

<u>Basis</u>: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.7.

3.1.2 Systems and Major Components

The Subsystems and Major Components contained within the mixer pump system are:

- Mixer Pump,
- Pump Motor,
- Pump Turntable,
- Pump Support, and
- Vertical Indexing.

The Mixer Pump System is described in further detail in Section 4.0.

3.1.2.1 Mixer Pump

a. **<u>Requirement</u>:** Mixer pumps shall be designed to operate with the Net Positive Suction Head (NPSH) available defined in RPP-5585 or operational or design provisions shall be made to operate pumps in an acceptable manner.

<u>Basis</u>: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.3.1.i and 3.2.5.2.4, as modified by engineering judgment.

b. **<u>Requirement</u>:** Each mixer pump shall provide two jets, 180° opposed, with velocity-nozzle diameter product (U_oD) that is a minimum of 29.4 ft^2/s (2.73 m^2/s) at 100 percent speed with a minimum impeller submergence of 3 ft (91 cm).

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.2.1.1.a, 3.2.1.2, 3.2.1.3, 3.2.1.4, 3.2.1.5, 3.2.1.6, 3.2.1.7, 3.2.1.8, and 3.2.1.9.*

c. **Requirement:** Pump seals or other design features upon failure shall not provide a pathway for tank waste liquids or gases to the environment.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.n.*

d. **Requirement:** Lifting bails and any special yokes or spreaders shall be provided that enable handling of the mixer pump in the horizontal and vertical positions, while allowing insertion of system into the DST.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.k.*

e. **Requirement:** The Mixer Pump System shall be capable of being lifted to an upright position from a horizontal position by a crane from a single point on the mounting flange end without damage to the pump or its components.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.l.*

f. **Requirement:** Lifting lugs or eye bolts for handling shall have a safety factor of 3 based on yield strength or 5 based on ultimate strength, whichever is most conservative.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.g.*

g. **Requirement:** Capability shall be provided to deliver raw water or diluent near the mixer pump suction area (sparge ring) to remove solids from below the pump and facilitate installation.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.o.*

h. **Requirement:** The Mixer Pump Subsystem shall not exceed the following demand for strained raw water. Filtering to $\leq$5 micron at the mechanical seal (if required by design) is part of pump design.

- Supply pressure = 551 kPa (80 lbf/in^2 gauge), or
- Flow rate = 0.3 L/s (5 gal/min).

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.1.2.1.2.a.*

i. **Requirement:** The Mixer Pump Subsystem shall not exceed the following demand for strained raw water. Filtering to ≤75 micron at the pump column (if required by design) is part of pump design.

- Supply pressure = 551 kPa (80 lbf/in^2 gauge), or
- Flow rate = 0.3 L/s (5 gal/min).

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.1.2.1.2.b.*

j. **Requirement:** Isolation valves shall be provided to isolate the water/diluent supply lines to the mixer pumps.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.2.g.*

k. **Requirement:** The mixer pump shall meet the applicable design, fabrication, and the highest degree of dynamic balancing and testing requirements contained in API 610.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.b.*

3.1.2.2 Pump Motor

a. **Requirement:** The mixer pump motor, if not of submersible design, shall be a vertical type and shall be designed to satisfy NEMA MG-1.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.3.1.e and 3.3.3.d.*

b. **Requirement:** The mixer pump motor shall be equipped with a variable speed drive.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.1.d.*

3.1.2.3 Pump Turntable

a. **Requirement:** The pump turntable assembly shall be located above grade.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.2.e.*

3.1.2.4 Pump Support

a. **Requirement:** The Mixer Pump System shall be capable of withstanding impingement forces placed on them by other mixer pumps in the same tank, with no damage or reduction in design life.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.6.

b. **Requirement:** The flange supporting the mixer pump weight shall be located above the cover blocks (if the pump is installed in a pump pit).

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.2.e.

c. **Requirement:** The pump column (if required by design) shall be drainable.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.d.

3.1.2.5 Vertical Indexing

a. **Requirement:** Overall mixer pump length must be confirmed on a tank-by-tank basis to ensure proper location of the suction and discharge nozzles.

Basis: This requirement is per engineering judgment and lessons learned.

b. **Requirement:** A vertical indexing system shall be provided, where necessary, to provide a mechanism to incrementally lower the mixer pump into tank solids. The system shall be based on information from HNF-EP-0182, and HNF-SD-WM-SP-012.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.2.2.i, 3.2.1.1.d, 3.2.1.2, 3.2.1.3, 3.2.1.4, 3.2.1.5, 3.2.1.6, 3.2.1.7, 3.2.1.8, and 3.1.2.9.

3.1.3 Boundaries and Interfaces

The Mixer Pump System has interfaces with seven other systems. Figure 3-1 provides a representation of the primary interfaces.

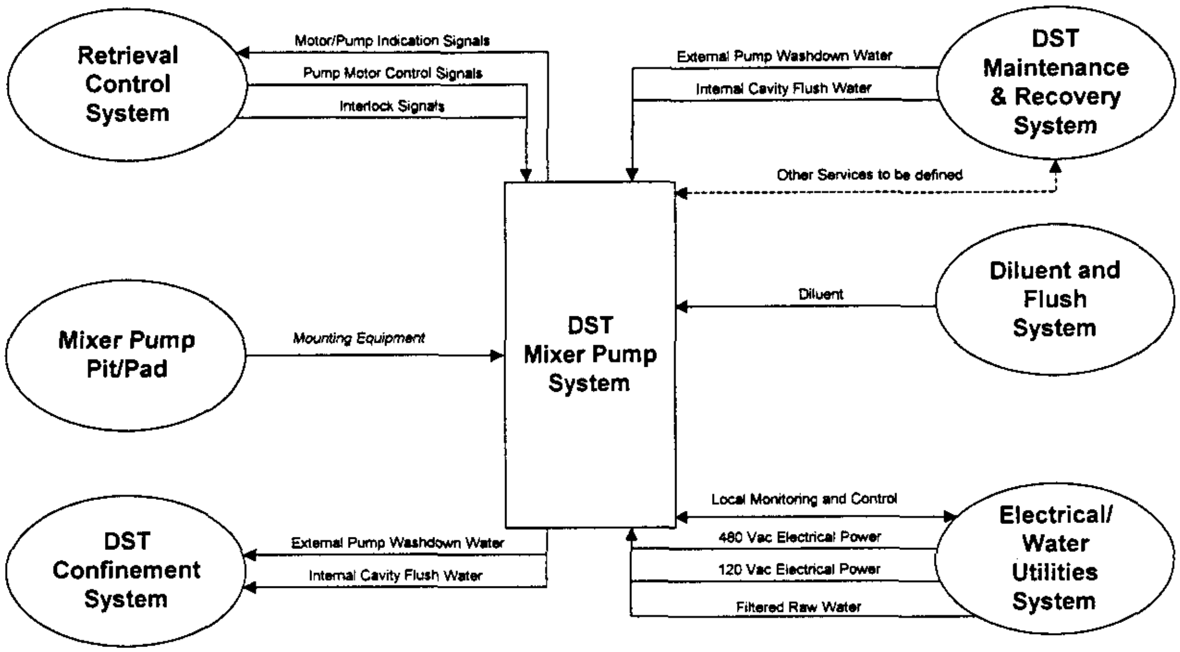


Figure 3-1. Primary Interfaces for the Mixer Pump System

a. **Requirement:** The Mixer Pump System shall provide a connection capable of providing water to the pump suction area (sparge ring) in order to remove sludge and settled solids from below the pump to facilitate pump installation, aid pump start-up after periods of inactivity, and add bulk dilution water.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.o.

b. **Requirement:** The Mixer Pump System shall provide a connection capable of providing water at ≥200 gal/min (760 L/min) to the pump cavity to enable flushing of the pump cavity to clear accumulated solids and internal flushing for decontamination at end of life.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.5.

c. **Requirement:** For pumps installed in 42-in. (107-cm) nominal diameter risers, the maximum diameter of pump components below the mounting flange shall be limited to 39 in. (99 cm) or larger verified dimension, which allow easy installation/removal.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.2.a.

d. **Requirement:** For pumps installed in 34-in. (86-cm) nominal diameter risers, the maximum diameter of pump components below the mounting flange shall be limited to 31 in. (79 cm) or larger verified dimension, which will allow easy installation/removal.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.2.b.

e. **Requirement:** Mixer pump components located above the mounting flange shall not extend more than 61 cm (24 in.) radially from the pump centerline in order to be compatible with the maximum LLCE receiver design.

Basis: This requirement is based on the need to assure compatibility with the flexible receiver apparatus for pump retrieval.

3.1.4 Codes, Standards and Regulations

3.1.4.1 Government Documents

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State constitute a part of the requirements for this SDD. These regulatory documents are listed in Table 3-1.

Table 3-1. Government Documents

Document Number	Title
DOE 5820.2A, 1988	*Radioactive Waste Management,* U.S. Department of Energy, Washington, D.C.
DOE 6430.1A, 1989	*General Design Criteria,* U.S. Department of Energy, Washington, D.C.
DOE/RL-96-109, Rev. 0	*Hanford Site Radiological Control Manual (HSRCM-1),* U.S. Department of Energy-Richland Operations Office, Richland, Washington.
RCRA, 1976	*Resource Conservation and Recovery Act of 1976, 42 USC 6901.*
10 CFR 835	Occupational Radiation Protection, Code of Federal Regulation, dated 11/98, Washington, D.C.

3.1.4.2 Non-Government Documents

National codes, standards, and the Hanford Site documents that form a basis for the Mixer Pump System requirements are listed in Table 3-2. Note: The RPP-PROs implement federal and state regulations and DOE Orders. In addition, it should be noted that some requirements are based on the existing authorization basis documents (HNF-SD-WM-SAR-067, HNF-SD-WM-TSR-006, etc.). In addition, the list of procedures is not intended to be complete, but rather to identify key ones which, when implemented, will support successful completion of design activities. Other specific procedures/documents are referenced throughout the sections of this document.

Table 3-2. Non-Government Documents

Document Number	Title
AASHTO, H20-44, 1996	*Standard Specification for HS-20, Highway Loading*, American Association of State Highway and Transportation Officials.
ASME B31.3, 1999	*Process Piping*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section V, 1998	*Non-Destructive Examination*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section IV	*Heating Boilers*, American Society of Mechanical Engineers, New York, New York.
ANSI Z358.1-1990	*Emergency Eyewash and Shower Equipment*, American National Standards Institute.
ASME NQA-1, 1994	*Nuclear Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP-PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP-PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP-PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP-PRO-701, Rev. 0, 1999	*Safety Analysis Process – Existing Facility.*
RPP-PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP-PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP-PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*
RPP-PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP-PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP-PRO-1819, Rev. 0, 1999	*PHMC Engineering Requirements.*
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2937, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2962, 1998	*A List of Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC) Requirements*, Numatec Hanford Corporation for Fluor Daniel Northwest for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 1A, 1999	*RPP Administration Tank Farm Operations Equipment Labeling and Master Equipment List Control*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-MP-599, Rev. 3, 1999	*Project Hanford Quality Assurance Program Description*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TRD-007, Rev. E Draft, 1998	*System Specification for the DST System*, COGEMA Engineering for Fluor Daniel Hanford, Richland, Washington.

Document Number	Title
HNF-SD-WM-TSR-006, Rev. 0-R, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
NACE RP 0169-96, 1996	*Control of External Corrosion Engineers*, Houston, Texas.
HNF-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-HSP-002, Rev. 3A, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-5183, Rev. 0, *1999*	Tank Farms Radiological Control Manual, Fluor Daniel Hanford, Richland, Washington.
HNF-Latest Revision	Hoisting and Rigging Manual

3.1.5 Operability

a. **Requirement**: The Mixer Pump System shall be designed to prevent collateral damage to tank structures and components (e.g., risers, tanks, pits, etc.) from the pump systems or components during any credible Design Basis Accident (DBA).

__Basis__: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.6.2.a.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

a. **Requirement:** The Mixer Pump System design shall provide means of internally flushing the pump bowl or volute to reduce internal contamination levels before or during pump removal from tank.

__Basis:__ This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.f.

b. **Requirement:** Designs should simplify cut-up, dismantlement, removal, and packaging of contaminated pumps in accordance with DOE Order 6430.1A, Section 1300-11.2.

__Basis:__ This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.c.

c. **Requirement:** The Mixer Pump System and components shall be designed in accordance with the safety classification for each. The safety classification shall be determined using the process described in RPP-PRO-700, RPP -PRO-702, RPP -PRO-703, and RPP -PRO-704, based on the guidelines in HNF-SD-WM-SAR-067, Section 3.0.

__Basis:__ This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.6.3.a.

d. **Requirement:** The Mixer Pump System shall not fail in such a way as to prevent removal of the pump from the tank following any credible DBA.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.4.b.

e. **Requirement:** All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Sections 0110-99.0.1, 0205-2, and 1300-11.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.a.

f. **Requirement:** All welds that will be in contact with waste shall be designed to eliminate crud traps. <TBR>

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.b.

3.2.2 ALARA

a. **Requirement:** Mixer pump shielding shall be designed to keep personnel exposures as low as reasonably achievable (ALARA) in accordance with RPP -PRO-1621 and RPP -PRO-1622.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.6.1.a.

3.2.3 Nuclear Criticality Safety

N/A

3.2.4 Industrial Hazards

a. **Requirement:** The Mixer Pump System shall incorporate occupational safety and health design features that comply with the requirements of HNF-SD-WM-HSP-002.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.6.1.b.

3.2.5 Operating Environment and Natural Phenomena

a. **Requirement:** The system shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501, *Natural Phenomena Hazards, Hanford Site, Richland, Washington.*

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.5.1.a.*

b. **Requirement:** The Mixer Pump System shall be designed to comply with the ignition control requirements per HNF-SD-WM-TSR-006.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.6.3.b.*

c. **Requirement:** The in-tank temperature range for mixer pump design is 10 to 104°C (50 to 220°F).

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.5. Note: W-521 will not meet requirement as waste would boil at referenced temperature. CHG to revisit specification requirement.*

3.2.6 Human Interface Requirements

Human performance/human engineering requirements are not applicable to the mixer pump system.

3.2.7 Specific Commitments

No specific commitments have been identified.

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

a. **Requirement:** All pump structural connections that require welding shall be welded in accordance with American Welding Society (AWS) D1.1.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.c.*

b. **Requirement:** The Mixer Pump System support foundations shall be designed in accordance with ACI 349.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.2.1.j.*

c. **Requirement:** Structural steel components shall be designed and fabricated in accordance with AISC specifications.

Basis: *Good Engineering Practice.*

3.3.2 Mechanical and Materials

a. **Requirement:** Mixer pump mechanical components, including pump seals, shall be capable of performing their intended functions from 100 rpm percent to 100 percent rated full speed. <TBR>

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.1.c.

b. **Requirement:** The system should use appropriate stainless steel for components that will be in contact with the waste and vapor space environments to aid in decontamination.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.3.8.i.

c. **Requirement:** All pump piping connections shall be designed and welded in accordance with American Society of Mechanical Engineers (ASME) B31.3

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.d.

d. **Requirement:** Mixer pumps shall be provided with a stamped stainless steel tag with the following data: manufacturer's name, manufacturer's part/item number, drawing number, year manufactured, and specification number and revision(s).

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.3.b.

e. **Requirement:** The mixer pump identification tag shall be visible after pump installation.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.3.c.

f. **Requirement:** Surface finishes of pump components below the riser flange shall be established after a cost/benefit analysis at detail design by the project.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.e.

g. **Requirement:** Internal and external cracks, crevices, and hold-up points shall be minimized to facilitate pump cleanup for disposal.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.g.

h. **Requirement:** Internal voids below the maximum waste level shall either be flushable, pressurized, filled, or sealed to minimize the pump's source term of radioactive material at end of life.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.8.h.

i. **Requirement:** System components shall be designed to withstand the shock and vibration environments during normal transportation.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.6.

3.3.3 Chemical and Process

a. **Requirement:** Components in contact with tank waste shall be designed to perform their intended function in the chemical environment defined in *Best-Basis Inventory* (database).

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.

3.3.4 Electrical Power

a. **Requirement:** Mixer pump motors shall be equipped with either a Variable Frequency Drive (VFD) or equivalent speed control system, capable of operating the mixer pump between 100 rpm and 100 percent of rated full speed <TBR>. Low-speed torque characteristic of the motor/VFD should be examined in with respect to initial starting waste viscosity.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.3.1.j, 3.2.1.1.c, 3.2.1.2, 3.2.1.3, 3.2.1.4, 3.2.1.5, 3.2.1.6, 3.2.1.7, 3.2.1.8, and 3.2.1.9.

b. **Requirement:** A VFD capable of controlling rotational speed from 0.05 to 0.2 rev/min shall power the mixer pump turntable drive.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.1.b.

c. **Requirement:** The power supply to the mixer pump motor and the turntable VFDs shall be 480 VAC, 3-phase, 60 Hz.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Sections 3.1.2.1.1.a.

d. **Requirement:** Electrical equipment enclosures shall be industrial controls and systems NEMA ICS 6 Standards.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.f. Note: the Design Authority is processing paperwork to resolve issue. Electrical enclosures and junction boxes of the proper NEMA rating shall be utilized.

e. **Requirement:** Electrical grounding shall be provided for all Mixer Pump System electrical systems in accordance with the National Electrical Code (NFPA 70, 1999).

Basis: This requirement is per good engineering practice.

f. **Requirement:** The mixer pump motor, if not of submerged design, shall conform to NEMA MG-1 requirements.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.e.

g. **Requirement:** Motors shall be provided with a stamped stainless steel identification tag in accordance with NEMA MG-1 requirements.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.d.

h. **Requirement:** Electrical materials and equipment shall be Underwriters Laboratories (UL) or FM tested, with label attached, for the purpose intended, whenever such products are available. Where there are no UL or FM listed products of the type, testing and certification by the River Protection Project (RPP) Design Authority in conjunction with the Flammable Gas Equipment Advisory Board, or by a nationally recognized testing laboratory shall be acceptable.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 4.1.2.a.

3.3.5 Instrumentation and Control

a. **Requirement:** The Mixer Pump System shall include sensors/instrumentation to provide remote readout of the following parameters: bearing temperature, pump vibration, motor stator winding temperature, turntable rotation and orientation, discharge nozzle pressure, sweep speed, revolutions per minute, and motor amperage. <TBR>

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.1.10.

b. **Requirement:** The Mixer Pump System shall provide fixed, non-rotating, environmentally protected field terminations for all power and signal connections that comply with applicable *National Electrical Codes* and standards.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.1.m.

c. **Requirement:** The system shall comply with electromagnetic radiation emission requirements set forth in Draft HNF-2962.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.2.

3.3.6 Computer Hardware and Software

There is no computer hardware associated with the Mixer Pump System.

3.3.7 Fire Protection

NA

3.4 Testing and Maintenance Requirements

3.4.1 Testability

Testability requirements shall be established based on detailed design and vendor information.

3.4.2 TSR-Required Surveillance

No technical safety requirement (TSR)-related surveillance requirements have been identified at this time.

3.4.3 Non-TSR Inspections and Testing

a. **Requirement:** Each mixer pump shall be tested for hydraulic and mechanical performance, vibration response, and other special testing as called out in *Hydraulic Institute Standards*.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 4.1.2.d.

b. **Requirement:** All lifting yokes shall be load tested to 125 percent of the rated load.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 4.1.2.d.

c. **Requirement**: Capability shall be demonstrated to lift the mixer pump assembly and lower it allowing straight vertical insertion into the DST.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 4.1.2.b.*

3.4.4 Maintenance

a. **Requirement**: All like equipment and parts shall be interchangeable/standardized to the maximum extent practical.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.5.*

b. **Requirement**: Components located within pump pits or below the mounting flange shall be designed for no preventive or corrective maintenance during the design life.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.3.c.*

c. **Requirement**: Components located below the riser flange or internal to a pump pit shall be designed for no maintenance, other than flushing or bumping.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.5.1.a.*

3.5 Other Requirements

3.5.1 Security and Special Nuclear Material (SNM) Protection

There are no security or SNM protection requirements identified for the Mixer Pump System.

3.5.2 Special Installation Requirements

There are no special installation requirements identified for the Mixer Pump System at this time.

3.5.3 Reliability, Availability, and Preferred Failure Modes

a. **Requirement**: The Mixer Pump System shall be designed for 5,000 hours of operation over a 10-year period, including repeated operational cycles with multiple starts/stops.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.3.a.*

b. **Requirement**: Mixer pump manufacturers shall provide written recommendations of operational practices such as bumping and flushing to maximize useful life.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.3.b.

c. **Requirement**: Minimum numbers of spares for like components shall be determined during design based on mean time between failure and the number of like components installed.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.5.2.a.

d. **Requirement**: The system shall be designed to withstand natural phenomenon hazards as specified in RPP-PRO-097. The system does not have to operate after a design basis earthquake; it only needs to be removable.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.5.1.b.

e. **Requirement**: The equipment design shall minimize the time required to physically disconnect, remove, and replace the mixer pump.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.2.4.a.

3.5.4 Quality Assurance

Requirement: Quality assurance requirements are shown on the master equipment list (MEL).

3.5.5 Miscellaneous

a. **Requirement**: Records, documents, and drawing control pertinent to design functions shall be in accordance with RPP-PRO-222 and RPP-PRO-224.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.4.a.

b. **Requirement**: The system design shall be verified to RPP-PRO-1819.

Basis: This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 4.2.

c. **Requirement**: The mixer pump system shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume IV, Section 4.14.

Basis: *This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0, Section 3.3.3.a.*

d. **Requirement:** The vertical indexing system (Type 3 pumps) shall be demonstrated for installation, removal, and indexing performance.

Basis: *This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, Section 4.1.2.f.*

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

4.1.1 Description of System, Systems and Major Components

Selection of a particular mixer pump type will include consideration of all waste types in the various W-521 tanks for Phase I waste feed delivery to assure that waste can be properly mixed at all waste levels and that the minimum of NPSH will be available.

Mixer pumps at each waste tank will be selected on a tank-by-tank basis from the following types: Type 1 - bottom suction and discharge; Type 2 - mid-level suction with bottom discharge; or Type 3 – vertical indexed bottom suction with bottom discharge.

A typical Type 1 mixer pump configuration is illustrated in Figure 4-1. Type 2 pump would preclude mixing between deliveries of HLW sub-batches as waste level falls in the staging tank. The mixer pump system at each waste tank includes the major components discussed in the following paragraphs.

4.1.1.1 Pump

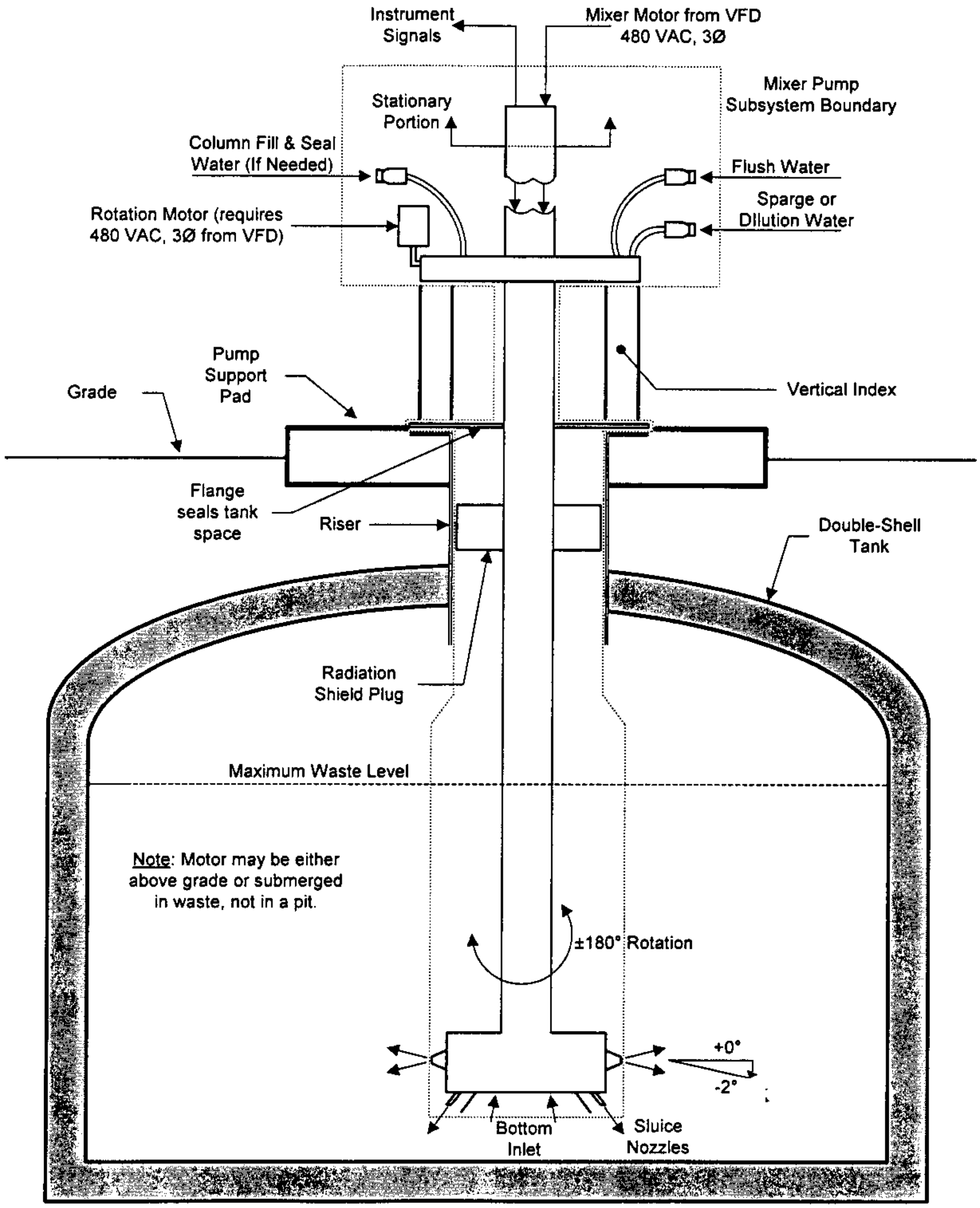
The major parts of the pump include the casing, discharge nozzles, suction strainer, suction inlet, and impeller. The pump has horizontal discharge nozzles.

4.1.1.2 Column

The major parts of the column include the shaft and couplings, bearings, mechanical seals, radiation shield support flange, and water supply piping and fittings.

4.1.1.3 Sparge Ring

A sparge ring will be provided on the pump casing (lower end) for delivering filtered raw water or diluent near the pump suction. The sparge ring is utilized to add bulk dilution water and to remove sludge and settled solids from below the pump during installation and prior to pump startup after periods of inactivity.



VAC = Volts alternating current
VFD = Variable Frequency Drive

Figure 4-1. Typical Mixer Pump Configuration

4.1.1.4 Turntable

The turntable mechanism is an integral part of the mixer pump assembly. An adapter flange will be provided for connecting the turntable to the support platform. The turntable mechanism includes an adjustable speed drive motor (0.05 to 0.2 rpm), ring gear drive system, and instrumentation for mixer pump rotational speed and nozzle orientation. The turntable mechanism is capable of operation in both clockwise and counterclockwise directions. The mixer pump assembly is fully functional without the turntable drive in operation.

4.1.1.5 Motor

The mixer pump will be driven by an electric motor designed for continuous service during tank mixing operations. The pump drive motor is a vertical induction type rated for the ambient environmental conditions to be encountered in an above ground installation. Heaters will be provided to prevent condensation when the motor is de-energized. The motor torque/speed characteristics will be determined with specific attention to the high viscosity of the waste at startup.

4.1.1.6 Variable Frequency Drive

Mixer pump speed will be controlled through a VFD system matched to the pump motor. The VFD has soft-start capability and will support mixer pump operation from 100 rpm to 100 percent of full rated speed <TBR>. Special handling equipment will be provided for shipping and installation.

4.1.1.7 Structural Support

The mixer pump structural support bears the weight of the pump, motor, turntable column, radiation shield plug, and other associated components. This structure ensures that the weight of the mixer pump is not born by the tank riser. The support has an opening to match the maximum outside diameter of the mixer pump components in the tank. The mixer pump structural support and its associated design requirements are described in further detail in W-521-SDD-08, Rev. 2, *Valve/Pump Pits/Cover Blocks System Design Description.*

4.1.1.8 Radiation Shield Plug

A shield plug is provided to prevent radiation streaming through the riser. The shield plug is supported from a support flange attached to the mixer pump column. Lessons learned from Project W-151 will be applied to the shield plug design.

4.1.1.9 Monitoring and Control

The DST Monitoring and Retrieval Control System provides monitoring and control of the Mixer Pump System. Further detail on the monitoring and controls for mixer pumps is found in W-521-SDD-04, Rev. 2, *Retrieval Control System Design Description.*

4.1.2 Boundaries and Interfaces

The Mixer Pump System interfaces with the DST Monitoring and Retrieval Control System; Electrical/Water Utilities System; Diluent and Flush System; Pump Pit/Pad; and the DST Confinement System (see Figure 3-1). An electrical pigtail from the pump motor interfaces with the Electrical System at a plugged connection. Instruments located on or in the pump and motor interface with the DST Monitoring and Retrieval Control System at connection points on the pump head assembly. The pump turntable assembly will be sealed and attached to a riser (part of the Tank Containment Boundary) in the pump pit.

4.1.3 Physical Location and Layout

The physical location of each mixer pump is identified in Table 4-1.

4.1.4 Principles of Operation

This document describes the functions of the mixer pumps when preparing LAW and HLW for transfer to alternate tanks. Mixing activities are three-fold. They are:

- It may be necessary to mobilize the solids which have been settled for long periods of time,
- While waste is stored in the tanks, it is desirable to mix/blend the waste to form a homogeneous feed, and
- Prior to transferring the waste it is necessary to suspend any settled solids in order to meet the transfer requirements.

The sequence of the activities for the entire process of waste transfer is discussed in two different documents: Grenard 2000, *"High-Level Waste Feed Process Control Strategy, Rev. 0,"* HNF-5145, CH2M Hill, Richland, WA, and Grenard 2000, *"Low-Level Waste Feed Process Control Strategy, Rev. 0,"* HNF-5146, CH2M Hill, Richland, WA.

Table 4-1. Mixer Pump Locations

Waste Tank	Location(s)	Pit	Riser Diameter	Pump Mount	Motor	Discussion	Assumptions
AY-101	Riser-01A		34-inch	Pit Cover Block	300 hp	Install Pump	(1) (3)
	Riser-01C		34-inch	Pit Cover Block	300 hp	Install Pump	(1) (3)
AY102	Riser 01A	AY-01B	34-inch	Pit Cover Block	300 hp	Remove Existing Mixer, Install pump	(3) (3)
	Riser 01C	AY-01D	34-inch	Pit Cover Block	300 hp	Remove Existing Transfer	(1) (3)
AW-101	Riser-007	None	42-inch	Concrete Slab	300 hp	Install Pump	(1) (3)
	Riser-008	None	42-inch	Concrete Slab	300 hp	Install Pump	(1) (3)
AW-103	Riser-007	None	42-inch	Concrete Slab	300 hp	Install Pump	(1) (3)
	Riser-008	None	42-inch	Concrete Slab	300 hp	Install Pump	(1) (3)
AW-104	Riser-007	None	42-inch	Concrete Slab	300 hp	Install Pump	(1)
	Riser-008	None	42-inch	Concrete Slab	300 hp	Install Pump	(1)
SY-101	Riser-013					Remove Existing Pump in SY-01A	(2) (3)
	Riser-007	None	42-inch	Concrete Slab	300 hp	Install Pump Relocate Multiport Assembly	(1) (3) (3)
	Riser-008	None	42-inch	Concrete Slab	300 hp	Install Pump	(1)
SY102	Riser-007	None	42-inch	Concrete Slab	300 hp	Install Pump	(1) (3)
	Riser-008	None	42-inch	Concrete Slab	300 hp	Install Pump	(1) (3)
SY-103	Riser-007	None	42-inch	Concrete Slab	300 hp	Relocate Instrument Tree Install Pump	(1) (3)
	Riser-008	None	42-inch	Concrete Slab	300 hp	Install Pump	(1) (3)

Assumptions for Table 4-1:

(1) Two 300 hp mixer pumps are necessary and adequate.
(2) The existing 150 hp mixer pump in SY-101 will not be adequate.
(3) Vertical indexing provided.

4.1.4.1 Prepare LAW in Source Tanks

Waste tanks AW-101, SY-101, and SY-103 have been identified as LAW source tanks. Waste preparation is performed prior to transferring LAW from the source tanks to the staging tanks in both 200 East and 200 West source tanks. The major process steps for waste preparation at LAW source tanks are crust softening (optional, not included in current planning), salt dissolution, and solids settling. Mixer pumps are utilized for waste preparation before transfer of any contents to staging tanks.

For tanks containing a high and/or dense solids level, a vertical indexing system will be used. This system will incrementally insert the pump, placing the suction near the solids level, mix to mobilize the upper solids layer then lower the pump to the news solids level and mix. This process will continue until the mixer pump is fully inserted.

Prior to salt dissolution, an initial supernate transfer may be necessary to allow sufficient water/diluent addition. During salt dissolution, most of the settled undissolved salts in the non-convective layer are dissolved by dilution, mobilization, and mixing with submerged jet mixer pump(s). Water or diluent can be added directly on top of the waste, by injection into the suction of a circulating transfer pump, or at the inlet to the mixer pump. With the pump off, the diluent flows into the tank, dissolving and diluting the waste at or near the point of entry. With the pump on, the diluent is forced through the non-convective layer in submerged jets that mobilize and dissolve salts.

The mixer pumps can be operated with the nozzles in a fixed position or in the oscillating mode. In the oscillating mode, the two diametrically opposed nozzles are rotated back and forth through up to 180° arcs. If a large gas release is detected during the mixing process, the mixer pump is shut off for a period of time to allow the ventilation system to reduce the potential concentrations of flammable and other gases.

After the waste is diluted and mixed, the mixer pump(s) is turned off and the undissolved solids are allowed to settle. In-situ solids distribution and settled solids level data are collected and samples are analyzed to verify adequate dissolution of the waste. Additional mixing time and/or diluent addition may be provided depending on results. After verification that the waste has been adequately diluted and mixed and the solids have settled, preparations are initiated for waste transfers to LAW staging tanks. In some cases, diluent addition, mixing, and supernate transfer may have to be performed more than one time to dissolve all possible soluble salts.

4.1.4.2 Waste Preparation in HLW Source Tanks

Waste tanks AY-101, AY-102, AW-103, AW-104, and SY-102 have been identified as HLW source tanks. Tank AW-104 is identified as both a LAW and HLW source. Waste preparation at HLW source tanks will involve waste mobilizing and solids suspension. Mixer pumps will be used for waste preparation in HLW staging tanks before transfer of any contents to staging tanks.

4.1.4.3 Mobilize HLW in Staging Tanks

Waste tanks AY-101, AY-102, and AW-104 have been identified as HLW staging tanks. It is expected that waste preparation in each HLW staging tank will be similar.

Settled solids at the bottom of the HLW staging tanks may form a hard heel after extended settling times and must be mobilized and suspended for retrieval and/or blending with other tank wastes. Vertical indexing of pumps will be performed, as necessary, in the same fashion as for LAW tanks.

Wastes that are transferred into HLW staging tanks from HLW source tanks may need to be mobilized if allowed to settle for long periods, or kept suspended if the settled waste depth would inhibit the operation of the mixer pump or transfer pump.

The HLW waste retrieval system for tanks AW-103 and AW-104 will use two 300-hp variable speed pumps. The pumps will be operated from speeds of 700 rpm to approximately 1200 rpm. Each pump has two opposing submerged jets that discharge 180 degrees apart and approximately 15 inches above the tank bottom. The pumps can also be rotated at various speeds for 180 degrees in either direction about their vertical axis. The rotation speed is variable from 0.0 5 rpm to 0.2 rpm.

Current planning is to operate both mixer pumps in the oscillating mode during waste mobilization. Scale model mixer pump experiments have indicated that at least 90 percent of the waste can be mobilized using the two mixer pump system. It is expected that the mixer pumps will need to be operated longer and/or at a higher speed during initial mobilization of the waste than when the waste needs to be re-suspended for transfer. Operation of two pumps in both the fixed and oscillating modes may be necessary to mobilize the waste. Operating parameters, including pump speed, pump oscillating speed, and duration of operation will be better defined after a full-scale demonstration test that will be performed prior to retrieval operations in conjunction with Project W-151.

The initial waste feed delivery operation will be to remove the settled sludge from the bottom of the tank and put the resulting waste particles into a slurry form. Operation of the mixer pumps will mobilize the settled waste in a radial direction from the centerline of the mixer pump. The mixer pumps will be operated in an oscillating mode such that the two opposing discharge jets will rotate 180° thus covering the entire tank. The extent that waste has been mobilized will be determined by measuring the radial distance that the waste has been removed from the tank bottom, or the effective cleaning radius (ECR).

4.1.4.4 Mix/Blend HLW in Staging Tank

The HLW feed delivery strategy includes combining wastes from different source tanks into a single feed staging tank. After the wastes are received, they will be blended together to make up a homogeneous HLW feed.

Mixer pump operation for blending will be essentially the same as that for waste mobilization. Current plans are to operate the pumps concurrently in the oscillating mode to obtain the most uniform mixture. It is expected that the pumps can be operated at a lower speed and/or for less time during blending than during waste mobilization since the settled and compacted solids have already been mobilized.

Controls for mixer pump operation will be provided to assure uniform waste blending. Waste contained must be qualified prior to transfer to the WTF. Prior to being sampled, the wastes will be mixed or blended by operation of the mixer pumps to obtain a uniform consistency of the waste. Controls are required to determine the speed the mixer pumps need to be operated at, how long the mixer pumps need to be run, and other modes of operation such as intermittent operation.

Waste uniformity during blending will be controlled by monitoring the waste profile during or immediately after mixer pump operation. Several methods can be used to perform this function, including measuring the suspended solids concentration, gamma activity above cesium, and slurry density, as a function of depth. In addition to slurry concentration profiles, slurry interface levels will provide additional information on waste homogeneity.

4.1.4.5 Suspend HLW in Staging Tank

The objective of waste suspension is to distribute the waste solids throughout the supernate to obtain uniform slurry that will meet both processing and transfer requirements. It is important that the waste is distributed uniformly throughout the tank so that batches transferred to the WTF will be consistent. The transfer pump suction will be near the tank bottom so that the maximum amount of the tank contents can be retrieved. The solids settling rate will therefore also be important as far as the timing of the transfers and the need to operate the mixer pumps during transfers to maintain the uniform waste concentration.

Mixer pump operation for solids suspension will be essentially the same as that for waste blending. Current plans are to operate the mixer pumps concurrently in the oscillating mode. Controls are required to determine the speed the mixer pumps need to be operated at, how long the mixer pumps need to be run, and other modes of operation such as intermittent operation.

Once the waste has been suspended, the mixer pumps will be turned off and the tank waste will be sampled to verify the waste concentrations are within the contractor specification limits and within site specifications for waste transfer. Sampling should be performed as soon as possible after the pumps have been turned off to provide a sample representative of a completely mixed tank without the effects of solids settling. Waste transfer can begin when specification requirements are confirmed.

4.1.5 System Reliability Features

System reliability features for the Mixer Pump System have not been identified at this time.

4.1.6 System Control Features

System control and monitoring features for the Mixer Pump System are described in W-521-SDD-04, *Retrieval Control System Design Description.*

4.1.6.1 System Monitoring

The Mixer Pump System includes sensors/instrumentation to provide remote readout of the following parameters: bearing temperature, pump vibration, motor stator winding temperature, turntable rotation and orientation, discharge nozzle pressure, sweep speed, revolutions per minute, and motor amperage. The DST Monitoring and Retrieval Control System will provide remote readout above the system parameters.

Most mixer pump control capabilities will be performed from the mixer pump control area (ICE Building) for the applicable tank farm. The DST Monitoring and Retrieval Control System will provide for remote-local control of mixer pump speed and turntable speed and direction of rotation.

4.1.6.2 Automatic and Manual Actions

The Mixer Pump System is operated, started and stopped manually from the remote mixer pump control area. Vertical indexing system for Type 3 pumps is accomplished with clamshell-type spacers at the pump location.

4.1.6.3 Setpoints and Ranges

Setpoints and ranges for the Mixer Pump System have not been identified.

4.1.6.4 Interlocks, Bypasses and Permissives

The DST Monitoring and Retrieval Control System provides mixer pump shutdown interlocks. Interlocks are provided for primary tank vapor space high pressure, waste high temperature, and high flammable gas concentration.

4.2 Operations

The WFD Operations and Maintenance (O&M) Philosophy provides the project with constraints and guidance on system operations and developing operations procedures. The O&M Philosophy and the WFD O&M Concept (HNF-1939) are the primary bases for developing the Project Operations Plan. System design and operation is optimized to support availability, reliability, and accommodate parallel processes where appropriate. Most of the concepts in the O&M Philosophy are related to keeping the WFD systems operating while supplying feed to the WTF and minimizing the shutdown time necessary for maintenance and repairs.

Prior to the initial system startup, readiness to start-up will be verified to meet the intent and requirements of the RPP procedure for facilities startup and readiness, RPP-PRO-55 "Facilities Start-Up Readiness" which implements U.S. Department of Energy (DOE) Order 425.1, *Startup and Restart, of Nuclear Facilities*. The level and type of review will be conducted at the lowest practical level commensurate with the project safety risk.

4.2.1 Initial Configuration (Pre-Startup)

Prior to system startup, the system will be configured such that only those valves, breakers and switches necessary to ensure a safe shutdown condition will require realignment. Operators in the field and in the control area should have the least number of components to reconfigure as possible. This reduces the likelihood that a critical component will be placed or remain in an improper position. Prior to each system startup, a thorough, step-by-step procedure will be used to place the system in the proper configuration for startup. This procedure will incorporate independent verification steps for all critical steps.

The mixer pump systems require qualified operators to perform initial valve, switch, and breaker line-ups in accordance with approved operating procedures prior to the start of each mixing operation. Where appropriate, remote position indicators will be used to provide critical information to the operator and provide input into the monitoring and control system.

4.2.2 System Start-up

Using the approved startup procedure, operators will start the system using the local-remote HMI from the ICE Building. The system is not designed to be started or operated from the field since all required parameters are not available for monitoring. It is only after all of the system parameters reach steady state conditions that the operators will return to a routine monitoring mode.

4.2.3 Normal Operations

An overview of normal mixer pump operations is provided in Section 4.1.4. After all equipment parameters reach steady state conditions, the operators will perform routine monitoring. Routine monitoring consists of recording parameters on data sheets periodically while being constantly alert for incoming alarms and other off-normal conditions.

Once the line-ups are complete, the control and operation of the mixer pumps will take place from a local-remote monitoring and control station. All critical parameters and their associated alarms will be monitored from this central location. Certain alarms and conditions will require qualified operators to go to the field for investigation. The majority of mixer pump starting and stopping will be performed by operators from a local-remote monitoring and control station. Critical operating parameters that could cause damage if limits are exceeded will provide alarms prior to exceeding these limits in order to allow the operators to take corrective action before the equipment shuts down automatically.

4.2.4 Off-Normal Operations

Off-normal operations will be covered in the applicable operating and emergency response procedures. Generally, the response to any off-normal situation will be to place the system in a safe, shutdown condition if initial operator response does not mitigate the situation. The on-duty operators may perform this shutdown in a controlled manner manually from the control area, or it may occur automatically, depending on the speed necessary to place the system in a safe condition.

4.2.5 System Shutdown

The mixer pump system will normally be shutdown from the control area. The system will be placed in such a condition so as to facilitate future startups while maintaining the facility in a stable shutdown status. After normal pump operations, a system flush (pump cavity, etc) will be performed to reduce the likelihood of waste from hardening in the pump internals.

4.2.6 Safety Management Programs and Administrative Controls

Safety management programs and administrative controls specific to the Mixer Pump System have not been identified. Mixer pump installation or initial mixer pump operation may induce a waste rollover in the tank, as a result of gas release event (GRE). An administrative control may have to be developed to mitigate or eliminate the risk associated with a mixer pump induced GRE.

4.3 Testing and Maintenance

4.3.1 Temporary Configurations

There are no temporary configurations identified for the mixer pump system.

4.3.2 TSR-Required Surveillance

No TSR related surveillances are identified at this time for waste feed delivery mixer pump systems.

4.3.3 Non-TSR Inspections and Testing

Specific non-TSR inspections and testing for the Mixer Pump System have not been identified. However, appropriate preventive and predictive maintenance will be performed to maintain the equipment in a satisfactory condition throughout the design life. Programs for exercising the mixer pump moving parts shall be implemented for long-term shutdown of the system to prevent binding. This could be done manually or by "bumping" the motors periodically. Flushing of the pump internals shall be performed regularly.

4.3.4 Maintenance

4.3.4.1 Post Maintenance Testing

Specific post maintenance testing activities for the Mixer Pump System have not been identified. However, post maintenance testing will be conducted to ensure maintenance is properly performed, the identified/original deficiency is corrected, and the equipment is restored to an operational status. Post maintenance testing will be performed and documented in accordance with HNF-IP-0842, Volume V, Section 7.2 "Post Maintenance Testing" and HNF-IP-0842, Volume IV, Section 4.28 "Testing Practices Requirements."

4.3.4.2 Post-Modification Testing

Specific post modification testing activities for the Mixer Pump System have not been identified. However, post modification testing will be essentially the same as post maintenance testing. Post modification testing is performed in accordance with the same guiding documents used for post maintenance testing.

RETRIEVAL CONTROL SYSTEM
SYSTEM DESIGN DESCRIPTION

Prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Task 00008
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Prepared by: Mike Garcia, P.E.

Approved by: RL Fritz
Robert L. Fritz

Date: 9-27-00

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Acronyms

ALARA	As Low As Reasonably Achievable
ANSI	American Nuclear Standards Institute
CAM	Continuous Air Monitor
CCTV	Closed Circuit Television
CMS	Central Monitoring Station
COB	Clean-out Box
DOE	U.S. Department of Energy
DST	Double-Shell Tank
GS	General Service
HMI	Human-Machine Interfaces
HNF	Hanford Nuclear Facility
HNF-PRO	Project Hanford Management Contract Procedure
ICE	Instrument, Controls and Electrical
MCS	Monitor and Control System
MOV	Motor Operated Valve
MPS	Master Pump Shutdown
NEMA	National Electrical Manufacturers Association
NUREG	U.S. Nuclear Regulatory Commission
PLC	Programmable Logic Controller
RCS	Retrieval Control System
RPP	River Protection Project
SC	Safety Class
SDD	System Design Description
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To Be Determined
TBR	To Be Refined
TFLAN	Tank Farm Local Area Network
TMACS	Tank Monitoring and Control System
TSR	Technical Safety Requirements
UL	Underwriters Laboratories
WFD	Waste Feed Delivery
WTF	Waste Treatment Plant
VFD	Variable Frequency Drive

1.0 INTRODUCTION

This Preliminary System Design Description (SDD) establishes the performance requirements and provides references to the requisite codes and standards to be utilized during definitive design for the Phase I Waste Feed Delivery System Project, W-521. It also identifies the system configuration to the extent defined by the advanced conceptual design.

1.1 System Identification

The W-521 Retrieval Control System (RCS) is a sub-system of the Double-Shell Tank (DST) Monitor and Control System. The W-211 RCS and W-314 Master Pump Shutdown (MPS) system are also sub-systems of the DST Monitor and Control System, and will interface and be compatible with the W-521 RCS. The W-314 MPS system is also referred to as the W-314 Monitor and Control System (MCS).

1.1.1 W-521 RCS

The Scope of the W-521 RCS is to support the waste mobilization retrieval and transfer activities in the following tanks:

- 241-SY-101, 102, 103
- 241-AW-101, 103, 104
- 241-AY-101, 102

W-521 is also installing Diluent and Flush Systems at 241-AW and 241-SY that will interface with the W-521 RCS.

The W-521 RCS is comprised of distributed Programmable Logic Controllers (PLCs), Human-Machine Interfaces (HMIs), and instrumentation.

1.2 Limitations

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary and conceptual in nature. This SDD will be a living document throughout the design phases of W-521, and will become more detailed as the design progresses through Definitive Design.

1.3 Ownership

This SDD is owned by the System Engineer responsible for WBS 1.2.4.

1.4 Definitions

General Service (GS) SSC – Structures, systems, or components (SSCs) not classified as either Safety Class or Safety Significant.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

    - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
    - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
    - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
    - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
    - Two Safety – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

    (**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

RPP Design Authority – A person qualified in the practice of engineering with four years demonstrated job related experience including two years in their specific functional areas. For nuclear structures, systems, or components, they shall have at least one-year nuclear experience.

Safety Class (SC) SSC – An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. SS also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall – Denotes a requirement.

Shall Consider – Requires that an objective assessment be performed to determine to what extent the specific factor, criterion, guideline, standard, etc., will be incorporated into or satisfied by the design. The results and basis of this assessment shall be documented. Such documentation shall be retrievable and can be in the form of engineering studies, meeting minutes, reports, internal memoranda, etc.

Should – Denotes a recommendation. If a "should" requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

Tank Opening – Tank risers and pits with an open path to the tank.

To be determined (TBD) – A study and/or calculation needs to be performed in order to provide a sufficient technical basis for the requirement.

To be refined (TBR) – A "soft" basis for the requirement has been identified. However, a further study and/or calculation need to be performed in order to solidify the requirement's technical basis.

Transfer-Associated Structure – Pump pits, valve pits, diversion boxes, or cleanout boxes.

2.0 GENERAL OVERVIEW

2.1 System Functions

The W-521 RCS provides monitoring and control systems and components necessary to assure that the functions of the Waste Feed Delivery Systems associated with W-521 Scope can be accomplished in accordance with all applicable requirements.

2.2 System Classification

The W-521 RCS and instrumentation associated with it is classified general service with the following exceptions. Project W-521 is installing SS pit leak detectors and pressure switches that will be hardwired to the SS portion of the new MPS W-314 System. These SS instruments provided by W-521 are part of the MPS System, and will detect the presence of waste in the pit or sense increase in pressure between the transfer piping and flushing system to shutdown transfer pumps.

The temperature probe assemblies used for monitoring tank waste temperatures are classified as SS. New temperature probes will be connected to Tank Monitoring and Control System (TMACS). TMACS is a safety-significant system.

2.3 Basic Operational Overview

The W-521 RCS will provide operations with the capability to monitor and control equipment from a local-remote HMI. The HMI is a personal computer running a graphical interface program that will be configured to handle most monitors and control activities specific to a Tank Farm.

The HMI is located near the tank farm in an Instrument, Controls and Electrical (ICE) building. The W-521 RCS will send data via Tank Farm Local Area Network (TFLAN) to a Central Monitoring Station (CMS) for remote monitoring. The CMS is part of the Master Monitor and Control System.

3.0 REQUIREMENTS AND BASIS

3.1 General Requirements

This section identifies the general requirements for the W-521 RCS and basis for these requirements.

3.1.1 System Functional Requirements

The System Functional Requirements are primarily derived from:

- Interface Control documents, WTF-5193-ID-19, and WTF-5193-ID-20.
- Waste Feed Delivery Technical Basis, HNF-1939, Rev. 0A.
- Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev.1 (DRAFT).

  Note: A review of the latest HNF-4155, Rev. 0, Double-Shell Tank Monitor and Control Subsystem Specification, was performed in order to determine any new requirements for instrumentation, monitoring and control.

  A new revision of HNF-4155 Rev.1, (DRAFT) was being circulated for final approval during the completion of the advanced conceptual design phase. It was decided during the advanced conceptual that the HNF-4155, Rev.1 (DRAFT) contained the necessary refinement and additional detail to more effectively support the advanced conceptual design effort.

- Double-Shell Tank Transfer Valving Subsystem Specification, HNF-4160, Rev. 0.
- Double-Shell Tank Transfer Piping Subsystem Piping Specification, HNF-4161, Rev. 0.

- Operations and Maintenance Philosophy, HNF-4553, Rev. 0.
- High-Level Waste Feed Process Control Strategy, HNF-5145, Rev. 0.
- River Protection Project Functions and Requirements Tank Farms Monitoring and Control Systems (Draft).

3.1.1.1 General Monitor and Control System

a. **Requirement:** Systems shall have the capability to be started and shut down locally. This requirement is intended to provide operations with an additional degree of freedom to operate a given system.

Basis: Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 2.0.

b. **Requirement:** Capability shall be provided to monitor and control retrieval operations from a local-remote station. A local-remote station is defined as a HMI usually located just outside the tank farm in an ICE building or an existing instrument building.

Basis: Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 2.0.

c. **Requirement:** Remote Central Monitoring capability shall be located in the 200 East Area and shall provide a view of the integrated transfer system that includes transfer routing, leak detectors, all interconnected tank levels, critical system status, and process control parameters. The requirement for the W-521 RCS is to send Waste Feed Delivery (WFD) related data to a Remote CMS.

Basis: Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 2.1.1.

d. **Requirement:** The control system shall have the capability to bypass all alarms and interlocks. The control system design shall also incorporate an appropriate level of administrative control.

Basis: River Protection Project Functions and Requirements Tank Farms Monitoring and Control Systems (Draft).

3.1.1.2 Mixer Pump

a. **Requirement:** Mixer pump operation is monitored to ensure proper operation and mechanical integrity of the pump, to prevent premature pump failure and to limit impingement on other in-tank equipment. Measured parameters will be used to detect mixer pump cavitation, plugged outlet nozzles, pump drive problems, and low seal- or bearing-water-supply.

Basis: High-Activity Waste Process Control Strategy, HNF-5145, Rev. 0, Section 3.2.3.1.

b. **Requirement**: If actual (in-tank) component deflections exceed allowable values, mixer pump operations may have to be altered. Options for mixer pump operation include running one pump instead of two, indexing the pump so that the jet does not impinge directly on the component, running the pump only in the fixed mode, or reducing the pump speed while passing the component.

Basis: *High-Level Waste Feed Delivery Process Control Strategy, HNF 5145, Rev. 1, Section 3.2.3.2.*

c. **Requirement**: The DST Monitor and Control Subsystem monitors mixer-pump operational parameters such as pump motor power draw; pump rotational speed; pump bearing and motor winding temperature; pump seal water flow; pump vibration; and pump nozzle pressure, position, and rotation speed.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT) Sections 3.1.2.1.7.*

d. **Requirement:** The DST Monitor and Control Subsystem shall respond to off-normal DST Tank Temperature. The following equipment will be automatically shut down upon detection of high waste temperature in a waste tank:

- Mixer Pumps
- Transfer Pump

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1,(DRAFT) Section 3.2.1.2.6.*

e. **Requirement:** The DST Monitor and Control Subsystem shall respond to off-normal ventilation system data. The following equipment shall be automatically shutdown upon detection of low-low vacuum in tank dome vapor space.

- Mixer Pumps
- Transfer Pump

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1 (DRAFT), Section 3.2.1.5.5.*

f. **Requirement**: The DST Monitor and Control Subsystem shall transmit operate mixer pump command as a control signal input for initiating, modifying, or halting the mixer pump operation. This function is provided to the Receive Operate Mixer Pump Command function. All pump auto/manual, on/off, and start/stop selections and indications will be provided to the monitoring system.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.21.1.*

g. **Requirement:** DST Monitor and Control Subsystem shall receive data from the Transmit Mixer Pump Operation Data function. Instrumentation shall provide the following monitoring and control functions for the mixer pump: motor speed and amperage, motor bearing temperature, motor stator winding temperature, turntable rotation and orientation, pump vibration, and nozzle discharge pressure.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.22.1.*

h. **Requirement:** DST Monitor and Control Subsystem shall compare mixer pump operational parameters with operational limits. Interlocks will be provided to prevent equipment damage or harm to the environment or personnel (this implies that a pump parameter is compared with an operational limit). The interlocks are:

- Motor Vibration (High-High)
- Motor Current (High-High)
- Motor Winding Temperature (High-High)
- Motor Upper and Lower Bearing Temperature (High-High)

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.22.2.*

i. **Requirement:** The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending (recording) of process parameters with report capability for a period of one week. Recorded parameters are:

- Motor Pump Speed
- Mixer Pump Current

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.22.3.*

j. **Requirement:** The DST Monitor and Control Subsystem shall provide indication of monitored parameters. Ranges and resolution <TBD>.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.22.4.*

k. **Requirement:** DST Monitor and Control Subsystem shall respond to off-normal mixer pump operational parameter by providing mixer pump shutdown interlocks. Shut down mixer pump for the following reasons:

- Motor Vibration (High-High)
- Motor current (High-High)
- Motor winding temperature (High-High)
- Bearing temperature (High-High)
- Off-normal values <TBD>.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.22.5.*

3.1.1.3 Transfer Pump

a. **Requirement:** For transfer pump control requirements in response to off-normal ventilation system data, see Section 3.1.1.2.e.

b. **Requirement:** The pump will be driven by an electric motor controlled by a VFD. The VFD controls pump-rotation speed and reports pump rotation speed and amperage to the control building. Pump speed and motor amperage will be used in conjunction with other data such as flow to verify that the pump is operating properly and to evaluate whether the transfer is proceeding satisfactorily.

Basis: *High-Activity Waste Process Control Strategy, HNF-5145, Rev. 0, Section 3.2.10.1.*

c. **Requirement:** WHC-SD-WM-DGS-006, Sections 4.2.2 and 4.6.5, establishes the bases for monitoring motor power draw and rotational speed. The basis for monitoring bearing and motor winding temperature is established in HNF-4553 and will be incorporated in the next revision of HNF-1939, Vol. IV.

Basis: *High-Activity Waste Process Control Strategy, HNF-5145, Rev. 0, Section 3.2.10.1.*

d. **Requirement:** Transfer stream parameters are measured to detect impending transfer line plugging, a plugged pump inlet, higher-than-expected waste viscosity, or stream density that is outside the acceptable range. The system shall monitor the following parameters:

- Transfer stream flow rate
- Transfer line pressure
- Transfer stream density (tentative)
- Transfer stream temperature (as a part of densitometer functionality).

Basis: *High-Activity Waste Process Control Strategy, HNF-5145, Rev. 0, Section 3.2.10.4.*

e. **Requirement:** The DST Monitor and Control Subsystem monitor the transfer pump rotational speed, power consumption, and seal gas flow and pressure. The DST Monitor and Control Subsystem also provide manual/automatic control of the transfer pump flow and pressure.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.1.2.1.4.*

f. **Requirement:** The DST Monitor and Control Subsystem shall respond to off-normal DST Tank Level. The following equipment will be automatically shut down upon detection of High-High waste level in a waste tank:

- Mixer Pumps
- Transfer Pump
- Close Caustic System Diluent outlet valve

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.3.6.*

g. **Requirement:** The following equipment will be automatically shut down upon detection of Low-Low tank waste level:

- Mixer Pumps
- Transfer Pump

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.3.6.*

h. **Requirement:** The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall receive a waste-backflow-detected indication from the Transmit Waste Backflow Detected function. The monitoring frequency of the leak detection system shall be continuous.

<u>Basis:</u> *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.9.1.*

i. **<u>Requirement:</u>** The DST Monitor and Control Subsystem shall transmit pump intake position command as a control signal for moving the transfer pump suction intake to the desired height within the DST. The output of this function is provided to the Receive Pump Intake Position Command function. The DST Monitor and Control Subsystem shall monitor and display the position of the suction bell by monitoring winch cable drum position. The DST Monitor and Control Subsystem also shall provide the capability to raise the suction bell to its uppermost position and hold it there while the mixer pump is operating.

<u>Basis:</u> *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.10.1.*

j. **<u>Requirement:</u>** DST Maintenance and Control Subsystem shall receive transfer pump suction intake position data from the Transmit Transfer Pump Suction Intake Position function. The DST Monitor and Control Subsystem will monitor and display the position of the suction bell by monitoring winch cable drum position. The DST Monitor and Control Subsystem also shall provide the capability to raise the suction bell to its uppermost position and hold it there while the mixer pump is operating.

<u>Basis:</u> *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.11.1.*

k. **<u>Requirement:</u>** The DST Monitor and Control Subsystem shall compare the winch (suction) position with the tank level. The tank level must be a least 61-cm (24-in.) above the winch (suction) position.

<u>Basis:</u> *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.11.2.*

l. **<u>Requirement:</u>** The DST Monitor and Control Subsystem shall display transfer pump suction intake position data. The nominal winch (suction) position will be shown on the overview and tank-specific screens.

- Range: 0 to 635 cm (0 to 250 in.)
- Resolution: 2.54 cm (1 in.)

<u>Basis:</u> *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.11.4.*

m. **Requirement:** The DST Monitor and Control Subsystem shall transmit operate transfer pump command as a control signal for initiating or halting the transfer pump operation or manually controlling pump speed to provide a desired flow or pressure. The output of this function is provided to the Receive Operate Transfer Pump Command function. The DST Monitor and Control Subsystem will provide pump auto/manual, on/off and start/stop selections and indications.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev1 (DRAFT), Section 3.2.1.12.1.*

n. **Requirement:** The DST Monitor and Control Subsystem shall receive pump run status from the Transmit Transfer Pump Operation Data function. Instrumentation will provide the following transfer pump monitoring and control functions to the DST Monitor and Control Subsystem:

- Motor Speed
- Motor Amperage
- Motor Winding Temperature
- Seal Gas Flow
- Seal Gas Pressure

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.13.1.*

o. **Requirement:** DST Monitor and Control Subsystem shall compare transfer pump operational data to operational limits. Interlocks for the following parameters will be provided to prevent equipment damage or harm to the environment or personnel.

- Motor Amperage
- Seal Gas Flow
- Seal Gas Pressure

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.13.2.*

p. **Requirement:** The DST Monitor and Control Subsystem shall record transfer pump operation data. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending (recording) of process parameters with report capability for a period of one week for:

- Motor Speed
- Motor Amperage

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.13.3.*

q. **Requirement:** The DST Monitor and Control Subsystem shall display transfer pump operation data received by the Receive Transfer Pump Operation Data function. The running status of waste transfer pumps shall be displayed at the waste transfer enunciator set of master pump shutdown system HMI graphical screens.

- Motor Speed Range: 0 to 100%
- Motor Current Range: 0 to 100%
- Motor Winding Temperature Range: 0 to 204°C (0 to 400°F)

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.13.4.*

r. **Requirement:** The DST Monitor and Control Subsystem shall respond to abnormal pump operation. The DST Monitor and Control Subsystem shall shut down transfer pump on High-High motor current or High-High-motor winding temperature. Off-normal values are programmable by Systems Engineer.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.13.5.*

s. **Requirement:** The DST Monitor and Control Subsystem shall receive waste transfer flow rate data from Transmit Waste Transfer Flow Rate function. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit the waste flow rate at the transfer pump discharge.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.14.1.*

t. **Requirement:** The DST Monitor and Control Subsystem shall compare waste transfer flow rate data received by the Receive Waste Transfer Flow Rate function to operational limits to initiate an alarm of off-normal flow and/or provide automatic flow control, as required. Monitoring and control of the waste transfer flow rate will be programmed into the PLC, including proportional, integral, and derivative (PID) algorithms. Flow rate (mass flow and volumetric flow) loop accuracy shall be ±5 percent of process range.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.14.2.*

u. **Requirement:** The DST Monitor and Control Subsystem shall record waste transfer flow data. The DST Monitor and Control Subsystem shall record transfer pump flow rate continuously (mass flow and volumetric flow).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.14.3.*

v. **Requirement:** The DST Monitor and Control Subsystem shall display waste transfer flow rate received by the Receive Waste Transfer Flow Rate function. The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the waste transfer enunciator set of master pump shutdown machine interface graphical screens. Flow-rate range is 0- to 757 L/min (0- to 200 gal/min) <TBR>.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.14.4.*

w. **Requirement:** The DST Monitor and Control Subsystem shall respond to abnormal waste transfer flow rate <TBR>. The transfer pump shall have a discharge flow low-low interlock. (Flow value <TBD>)

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.14.5.*

x. **Requirement:** The DST Monitor and Control Subsystem shall receive transfer pump discharge pressure from the Transmit Transfer Pump Discharge Pressure Data function. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit transfer pump discharge pressure.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.15.1.*

y. **Requirement:** The DST Monitor and Control Subsystem shall compare waste transfer pump discharge pressure data with operational limits. Pressure loop accuracy shall be ± 5 percent of process range.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.15.2.*

z. **Requirement:** The DST Monitor and Control Subsystem shall record transfer pump discharge pressure data. The DST Monitor and Control Subsystem shall continuously record transfer pump discharge pressure.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.15.3.*

aa. **Requirement:** The DST Monitor and Control Subsystem shall display transfer pump discharge pressure data. The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the waste transfer enunciator set of master pump shutdown machine interface graphical screens. Pressure range is 0- to 5960 kPa (0- to 850 lbf/in^2) <TBD>.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.15.4.*

bb. **Requirement:** The DST Monitor and Control Subsystem shall respond to abnormal pump discharge pressure. The transfer pump shall have a discharge pressure High-High interlock. (Pressure value <TBD>).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.15.5.*

cc. **Requirement:** The DST Monitor and Control Subsystem shall receive the Waste Transfer Density/Temperature Data from the Transmit Waste Transfer Density/Temperature Data function. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit waste density (and temperature) at the transfer pump discharge.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.16.1.*

dd. **Requirement:** The DST Monitor and Control Subsystem shall compare waste density/temperature data with operational limits. Density shall have a loop accuracy of ± 5 percent of process range. Temperature shall have a loop accuracy of ± 2.8 °C (± 5 °F).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.16.2.*

ee. **Requirement:** The DST Monitor and Control Subsystem shall record waste density data received by the Receive Waste Transfer Density/Temperature Data function. The system shall continuously record density and temperature of waste being transferred.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.16.3.*

ff. **Requirement:** The DST Monitor and Control Subsystem shall display waste density/temperature data. The dynamic analog data associated with waste transfer routes shall be displayed on the waste transfer annunciator set of master pump shutdown HMI graphical screens. Density range is 0.9000 to 1.5000 g/cm^3 with an accuracy of 0.0005 g/cm^3 <TBD>. Temperature range is –10 to 200 °C (14 to 392 °F) with an accuracy of ± 2.8 °C (± 5 °F).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.16.4.*

gg. **Requirement:** The DST Monitor and Control Subsystem shall respond to abnormal waste density/temperature <TBD>.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.16.5.*

3.1.1.4 In-Tank Monitoring

a. **Requirement:** The process control strategy for ensuring the integrity of in-tank components during mixer pump operations will be to monitor component deflections using a closed-circuit television, and to compare the readings to calculated values.

Basis: *High-Level Waste Feed Delivery Process Control Strategy, HNF-5145, Rev. 0, Section 3.2.3.2.*

b. **Requirement:** Instrumentation to measure sludge mobilization, blending, and suspension parameters, including the suspended solids profiler, gamma profiler, and ultrasonic interface level detector, will be tested in conjunction with mixer pump testing (HNF-SD-WM-PTP-027, *Mixer Pump Test Plan for Double-Shell Tank 241-AZ-101*). Successful testing of these instruments may justify monitoring additional process control parameters.

Basis: *High-Level Waste Feed Delivery Process Control Strategy, HNF-5145, Rev. 0, Section 1.3.*

c. **Requirement:** Tank waste temperatures will be monitored to ensure that temperatures necessary for potential tank bumps and for organic salt-nitrate reactions to occur are not exceeded. If either of these limits is exceeded, action shall be taken to mitigate the cause of the temperature increase and to restore waste temperatures to within allowable limits.

Basis: *High-Level Waste Feed Delivery Process Control Strategy, HNF-5145, Rev. 0, Section 3.2.2.3.*

d. **Requirement:** The DST Monitor and Control Subsystem shall receive tank structure temperature signals from the DST Confinement Subsystem. All tank bottom insulating concrete thermocouple signals shall be received at the DST Monitor and Control Subsystem I/O as required, at a selectable poling rate, for tanks that contain sludge that is mobilized by mixer pumps. Tank dome, middle wall, and bottom wall structure thermocouple signals shall be received as required, at a selectable poling rate at the DST Monitor and Control Subsystem I/O.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.1.1.*

e. **Requirement:** The DST Monitor and Control Subsystem shall compare tank bottom insulating concrete thermocouples to base line conditions to assess sludge mobilization and also compare other tank structure temperatures to operational limits. Tank bottom insulating concrete thermocouple data provides an indication of sludge mobilization when baseline temperature is compared to temperature after mixer pumps have been run (exempt from concrete temperature limits).

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.1.2.

f. **Requirement:** The temperature gradients of dome and wall concrete shall be $\leq .72\ ^{\circ}$C/cm (35 $^{\circ}$F/ft) for AP, AW, AN, and SY tanks; and $\leq .37\ ^{\circ}$C/cm (18 $^{\circ}$F/ft) for AY and AZ tanks.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.1.2.

g. **Requirement:** The dome and wall temperature change shall be $\leq 5.6\ ^{\circ}$C (10 $^{\circ}$F) /hr if the waste is $< 57\ ^{\circ}$C (125 $^{\circ}$F) or $\leq 11.2\ ^{\circ}$C (20 $^{\circ}$F) if the waste is $\geq 57\ ^{\circ}$C (125 $^{\circ}$F).

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.1.2.

h. **Requirement:** The DST Monitor and Control Subsystem shall record tank structural thermocouple data. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.1.3.

i. **Requirement:** The DST Monitor and Control Subsystem shall display tank structural thermocouple data. The DST Monitor and Control Subsystem shall provide indication of monitored parameters [resolution $\pm .06\ ^{\circ}$C ($\pm .1\ ^{\circ}$F)].

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.1.4.

j. **Requirement:** There are no automatic responses to off-normal DST Structure Temperature identified for the DST Monitor and Control Subsystem other than to provide audible and visual annunciation for all alarm conditions.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.1.5.

k. **Requirement:** The DST instrument and control component of the DST Monitor and Control Subsystem shall measure DST tank waste temperature. Temperature sensor probes:

- Range: 10 to 149 °C (50 to 300 °F)
- Loop Accuracy: ± 2.8 °C (± 5 °F)

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.2.1.*

l. **Requirement:** The DST Monitor and Control Subsystem shall receive tank waste temperature data. DST Monitor and Control System shall receive DST Tank Waste Temperature from TMACS, at a selectable poling rate, via TFLAN for those temperature probes that are monitored by TMACS.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.2.2.*

m. **Requirement:** DST Monitor and Control System shall receive DST Tank Waste Temperature continuously at DST Monitor and Control System local I/O for those temperature probes that are not monitored by TMACS.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.2.2.*

n. **Requirement:** The DST Monitor and Control Subsystem shall compare tank waste temperature to operational limits and also control WFD processes. The waste temperature shall be either:

≤ 91 °C (195 °F) in all levels of the waste.
OR
≤ 91 °C (195 °F) in the top 4.6 meters (15 feet) of the waste
AND
≤ 107 °C (215 °F) in the waste below 4.6 meters (15 feet).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.2.3.*

o. **Requirement:** The DST Monitor and Control Subsystem shall record tank waste temperature. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, Section 3.2.1.2.4.*

p. **Requirement:** The DST Monitor and Control Subsystem shall display tank waste temperature. The DST Monitor and Control Subsystem shall provide indication of monitored parameters [resolution ± .06 °C (.1 °F)].

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.2.5.*

q. **Requirement:** For in-tank monitoring requirements related to off-normal DST temperature, see Section 3.1.1.2.d.

r. **Requirement:** The DST instrument and control component of the DST Monitor and Control Subsystem shall measure DST tank waste level. Measurement Parameters:

- Range: 0- to 1072 cm (0- to 422 in.) AN, AP, AW, and SY tanks
- Range: 0- to 940 cm (0- to 370 in.) AY and AZ tanks
- Resolution: + 0.03 cm (0.1 in.)
- Loop accuracy: + 0.6 cm (1/4 in.)

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.3.1.*

s. **Requirement:** The DST Monitor and Control Subsystem shall receive tank waste level data. DST Monitor and Control Subsystem shall receive DST Tank Waste Level from TMACS via TFLAN, at a selectable poling rate, for those level gauges that are monitored by TMACS.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.3.2.*

t. **Requirement:** DST Monitor and Control Subsystem shall receive DST Tank Waste Level directly at the DST Monitor and Control System local I/O for those level gauges that are not monitored by TMACS.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.3.2.*

u. **Requirement:** DST Monitor and Control Subsystem shall compare tank waste level to operational limits. Interlocks for High High and Low-Low waste level will be provided to prevent equipment damage or harm to the environment or personnel. Interlock values differ from tank to tank.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.3.3.*

v. **Requirement**: The DST Monitor and Control Subsystem shall record tank waste level. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.3.4.*

w. **Requirement**: The DST Monitor and Control Subsystem shall display tank waste level. The DST Monitor and Control Subsystem shall provide indication of monitored parameters.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.3.5.*

3.1.1.5 Diluent/Flush System

a. **Requirement**: The DST Monitor and Control System shall receive data from the Diluent/Flush Water System. The DST Monitor and Control Subsystem shall receive the following data from the Diluent/Flush Water System.

- Diluent/Flush Water Temperature
- Diluent/Flush Water Pressure
- Diluent/Flush Water Flow
- Diluent/Flush Water Chemical Composition
- Diluent/Flush Water Motor Operated Valve Position

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.8.1.*

b. **Requirement**: The DST Monitor and Control Subsystem shall compare diluent/flush water data with desired operating limits. The following parameters shall be compared to desired operating limits:

- Diluent/Flush Water Temperature
- Diluent/Flush Water Pressure
- Diluent/Flush Water Flow

- Diluent/Flush Water Chemical Composition
- Diluent/Flush Water Valve Position

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.8.2.*

c. **Requirement**: The DST Monitor and Control Subsystem shall record diluent/flush water data. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.8.3.*

d. **Requirement**: The DST Monitor and Control Subsystem shall display diluent/flush water data. The DST Monitor and Control Subsystem shall provide indication of monitored parameters.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.8.4.*

e. **Requirement**: The DST Monitor and Control Subsystem shall respond to off-normal diluent/flush water data. The DST Monitor and Control Subsystem shall place the Diluent/Flush outlet valve to the waste tank into recirculation mode upon detection of the following:

- Loss of 120 Vac power to Programmable Logic Controller Uninterruptible Power Supply
- Master Pump Shutdown
- Operator –Initiated Shutdown
- Waste Tank High-High Level

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.8.5.*

f. **Requirement**: The DST Monitor and Control Subsystem shall place the Diluent/Flush tank isolation valve in the closed condition upon detection of the following:

- Loss of 120 Vac power to Programmable Logic Controller Uninterruptible Power Supply
- Master Pump Shutdown
- Operator –Initiated Shutdown

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.8.5.*

g. **Requirement**: The DST Monitor and Control Subsystem shall provide data that will be used to perform material balance periodically during the waste transfer to determine that the amount of waste being delivered to the destination agrees with the amount of waste being removed from the source tank. Accuracy: ±0.6 cm (±1/4 in.) in sending and receiving tank plus transfer line volume as applicable for tank level to tank level material balance. Accuracy: ±5 percent of range for flow and ±0.6 cm (±1/4 in.) for level for totalized flow to tank level comparison.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1(DRAFT), Section 3.2.1.19.*

h. The DST Monitor and Control Subsystem shall receive Service Water Totalized Flow from the Transmit Service Water Totalized Flow function for those tank farms that provide service water transmitters. The service water usage shall be monitored every 24 hours.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.23.1.*

i. The DST Monitor and Control Subsystem shall compare service water totalized flow with operational limits. Compare current totalizer value with previous value to verify that there has been no unaccounted for service water usage.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.23.2.*

j. The DST Monitor and Control Subsystem shall record Service Water Totalized Flow data. Service Water Totalized Flow must be recorded from monitoring period to monitoring period to provide data to perform a usage comparison.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.23.3.*

k. The DST Monitor and Control Subsystem shall display Service Water Totalized Flow. Non-resettable Service Water Totalized Flow shall be displayed on the HMI graphical screens to provide visual access to the remotely transmitted totalizer value.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.23.4.*

3.1.1.6 Valve Control

a. **Requirement**: For Caustic Valve Supply System control response to High-High waste level, see Section 3.1.1.3.f.

b. **Requirement**: DST Monitor and Control Subsystem shall transmit motor-operated valve actuation control signal for remote control of valves in the transfer pump pits. This function transmits a control signal to the Receive Motor-Operated Valve Actuation function. All remote-controlled valve auto/manual and position selections and indications will be provided by the DST Monitor and Control Subsystem.

   Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.6.1.*

c. **Requirement**: The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall receive transfer valve position data from the Transmit Transfer Valve Position Data function. Project W-314 valve position sensors are connected to the DST master pump shutdown PLCs.

   Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.7.1.*

d. **Requirement**: All remote-controlled valve auto/manual and position selections and indications will be provided at the DST retrieval control system component of the DST Monitor and Control Subsystem.

   Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.7.1.*

e. **Requirement**: The RCS shall compare transfer valve position data with the desired position for selected route.

   Basis: *Good Engineering Practice.*

f. **Requirement**: The RCS shall record transfer valve position data. Provide prioritized, grouped, and time/date stamped alarm summary screen and event log.

   Basis: *Good Engineering Practice.*

g. **Requirement**: The RCS shall display transfer valve position data. Operational Requirements – shall be able to display the valve position graphically.

   Basis: *Good Engineering Practice.*

h. **Requirement:** The symbol for each open valve port will be green. The symbol each closed port will be white. When in transition, the valve symbols will be yellow.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.7.4.*

i. **Requirement:** The status of the valve position switches, leak detectors, and radiation detectors are monitored continuously for off-normal conditions that, when detected, provide interlocks that do not allow a transfer to begin or that terminate an existing transfer.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.7.1.*

j. **Requirement:** For Diluent/Flush outlet valve response to off-normal diluent/flush water data, see Section 3.1.1.5.f.

k. **Requirement:** For interlocks involving the Diluent/Flush tank isolation valve, see Section 3.1.1.4.5.e.

3.1.1.7 Instrumentation

a. **Requirement:** The aging waste tanks contain several components that are supported from the tank dome and hang in the tank. These components include ALCs, dry wells, thermocouple assemblies, and a steam-coil assembly. Calculations and analyses have been performed to determine the loads imparted by the mixer pumps that these in-tank pumps could withstand. The calculations were performed based on assumed sludge buildup on the components and corrosion factors. To mitigate the risk of a component failing in the tank, it is required that the structural integrity of the in-tank components be monitored during mixer pump operations.

Basis: *High-Level Waste Feed Delivery Process Control Strategy, HNF-5145, Rev 1, Section 3.2.3.2.*

b. **Requirement:** The low-point leak detector sensors shall be repairable or replaceable within 8 hours <TBD>. Time to repair does not include preparatory work such as preparing procedures, staging personnel and equipment, or preparatory training.

Basis: *Double-Shell Tank Transfer Valving Subsystem Specification, HNF-4160, Rev. 0, Section 3.2.4.h.*

c. **Requirement:** Electrical materials and equipment shall be Underwriters Laboratories, Inc. (UL)- or factory material (FM)-tested, with label attached, for the purpose intended, whenever such products are available. Where there are no UL- or FM-listed products of the type, testing, and certification by another nationally recognized testing agency may be acceptable. Installation methods shall be in accordance with the manufacturer's instructions, with *National Electrical Code*, NFPA 70, and with other applicable requirements.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.1.*

d. **Requirement**: All equipment installed in areas in and around the tank that are subject to ignition controls shall be designed to meet the requirements of HNF-SD-WM-TSR-006, Section 5.10, "Ignition Controls." Areas requiring controls are delineated in HNF-SD-WM-SAR-067, Appendix K. The Flammable Gas Equipment Advisory Board shall be consulted whenever the application or interpretation of the requirements is unclear.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.6.3.*

e. **Requirement**: All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Section 1300-11.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.8.*

f. **Requirement**: Designs should simplify cut-up, dismantlement, removal, and packaging of contaminated components.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.8.*

3.1.1.8 Leak Detectors

a. **Requirement:** Designs shall provide for the detection and isolation of electronic faults associated with valve position switches, pressure and flow elements, and leak detectors.

Basis: *Double-Shell Tank Transfer Valving Subsystem Specification, HNF-4160, Rev. 0, Section 3.5.1.g.*

3.1.1.9 Pit Leak Detectors

a. **Requirement:** Transfer-associated structures, including clean-out boxes, shall have leak detectors placed at the lowest point of the structure such that a leak can be detected within 24 hours.

Basis: *Double-Shell Tank Transfer Valving Subsystem Specification, HNF-4160, Rev. 0, Section 3.2.1.9.a.*

b. **Requirement:** A new pit leak-detector assembly and conductivity probe shall be designed and operated so that it will detect the failure of either the primary or secondary containment structure or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours, or at the earliest practicable time, if the owner or operator can demonstrate to the department that existing detection technologies or site conditions will not allow detection of a release within 24 hours and if the Washington State Department of Ecology approved the deviation from the requirements specified above.

Basis: *Double-Shell Tank Transfer Valving Subsystem Specification, HNF-4160, Rev. 0, Section 3.2.1.9.b.*

c. **Requirement:** The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall transmit transfer-associated structure leak sensor data to Receive Transfer-Associated Structure Leak Data function. The leak detection system sensor shall be compatible with the DST Monitor and Control Subsystem and the master pump shutdown system.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.17.1.*

d. **Requirement:** The DST master pump shutdown system component of DST Monitor and Control Subsystem shall receive transfer-associated structure leak sensor data from Transmit Transfer-Associated Structure Leak Data function. The monitoring frequency of the pit leak detection system shall be continuous.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.17.2.*

e. **Requirement:** The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall compare leak data to operating limits. The required response time of the pit leak detection system shall be instantaneous (less than or equal to 1 second).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.17.3.*

f. **Requirement:** The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall display transfer associated structure leak sensor data. The DST master pump shutdown system shall be able to display graphically on the HMIs the selected transfer routes (including status of input/output elements) in the waste transfer annunciator mode of operation.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.17.5.*

3.1.1.10 Encasement Leak Detectors

a. **Requirement:** The leak detector sensor combined with the secondary confinement seal loop jumper (from the DST Transfer Valving Subsystem) shall be designed and operated such that it will detect the failure of the primary containment or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours. The amount of anticipated leakage to actuate the leak detector shall be calculated during design of the system. The Washington State Department of Ecology, through the final status permitting process, may approve or disapprove the final system design.

Basis: Double-Shell Tank Transfer Piping Subsystem Specification, HNF-4161, Rev. 0, Section 3.2.1.3.a.

b. **Requirement**: The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall receive leak data from the Transmit Primary Confinement Piping Leak Detection Data function. The monitoring frequency of the low point leak detection system shall be continuous.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.18.2.

c. **Requirement**: DST Maintenance and Control Subsystem shall compare primary confinement piping leak data with operating limits. The required response time of the low point leak detection system shall be instantaneous (less than or equal to 1 second).

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.18.3.

d. **Requirement**: The DST master pump system shutdown component of the DST Monitor and Control Subsystem shall display primary confinement piping leak detection data. The DST master pump shutdown system shall be able to display graphically on the HMIs the selected transfer routes (including status of input/output elements) in the waste transfer annunciator mode of operation.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.18.5.

e. **Requirement:** The DST Monitor and Control Subsystem shall receive DST annulus primary leak data from TMACS via TFLAN for those tanks whose annuli are monitored by TMACS.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.4.2.

f. **Requirement:** The DST Monitor and Control Subsystem shall record DST annulus primary leak data. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.4.3.*

g. **Requirement:** The DST Monitor and Control Subsystem shall provide indication of monitored parameters.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.4.4.*

h. **Requirement:** There are no automatic responses to Annulus Primary Leaks identified for the DST Monitor and Control Subsystem other than to provide an alarm in response to the Compare function.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.4.5.*

3.1.1.11 Ventilation

a. **Requirement:** The DST Monitor and Control Subsystem shall receive the following DST ventilation system data from TMACS via TFLAN for those ventilation parameters monitored by TMACS:

- Tank vapor space pressure (-6 to +4 inches of water)
- Annulus exhaust stack beta (CAM) continuous air monitor alarm status
- Primary exhaust stack beta CAM alarm status
- Standard hydrogen monitor system (SHMS) hydrogen concentration and alarm status
- Primary exhauster run status
- Annulus exhauster run status
- HEPA filter differential pressure

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.5.1.*

b. **Requirement:** The DST Monitor and Control System shall receive DST ventilation system data directly at the DST Monitor and Control Subsystem local I/O for those ventilation parameters that are not monitored by TMACS. <TBD>

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.5.1.*

c. **Requirement:** The DST Monitor and Control Subsystem shall compare ventilation system parameters with the desired value or status. All ventilation parameters monitored by the DST Monitor and Control Subsystem except tank vapor space pressure are contact statuses from other equipment (The DST Monitor and Control Subsystem does not perform a comparison function). <TBD>

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.5.2.*

d. **Requirement:** Tank dome pressure shall be compared to operational limits. <TBD>

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.5.2.*

e. **Requirement:** The DST Monitor and Control Subsystem shall record DST ventilation system data. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week. <TBD>

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.5.3.*

f. **Requirement:** The DST Monitor and Control Subsystem shall display tank ventilation system data. The DST Monitor and Control Subsystem shall provide indication of monitored parameters. <TBD>

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.5.4.*

g. **Requirement:** The DST Monitor and Control Subsystem shall respond to off-normal ventilation system data. The following equipment shall be automatically shutdown upon detection of low-low vacuum in tank dome vapor space.

- Mixer Pumps
- Transfer Pump

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.5.5.*

3.1.2 Subsystem and Major Components

The W-521 RCS is made up of four subsystems or major components:

- PLC
- HMI
- Instrumentation
- Data Communications

3.1.3 Boundaries and Interface

a. **Requirement:** Project W-521 requires close coordination with all ongoing projects and existing facilities/operations to provide a fully integrated system that meets the functional requirements of the Waste Feed Delivery (WFD) mission. Figure 3-1 shows key elements of these interfaces.

Basis: *Good engineering practice.*

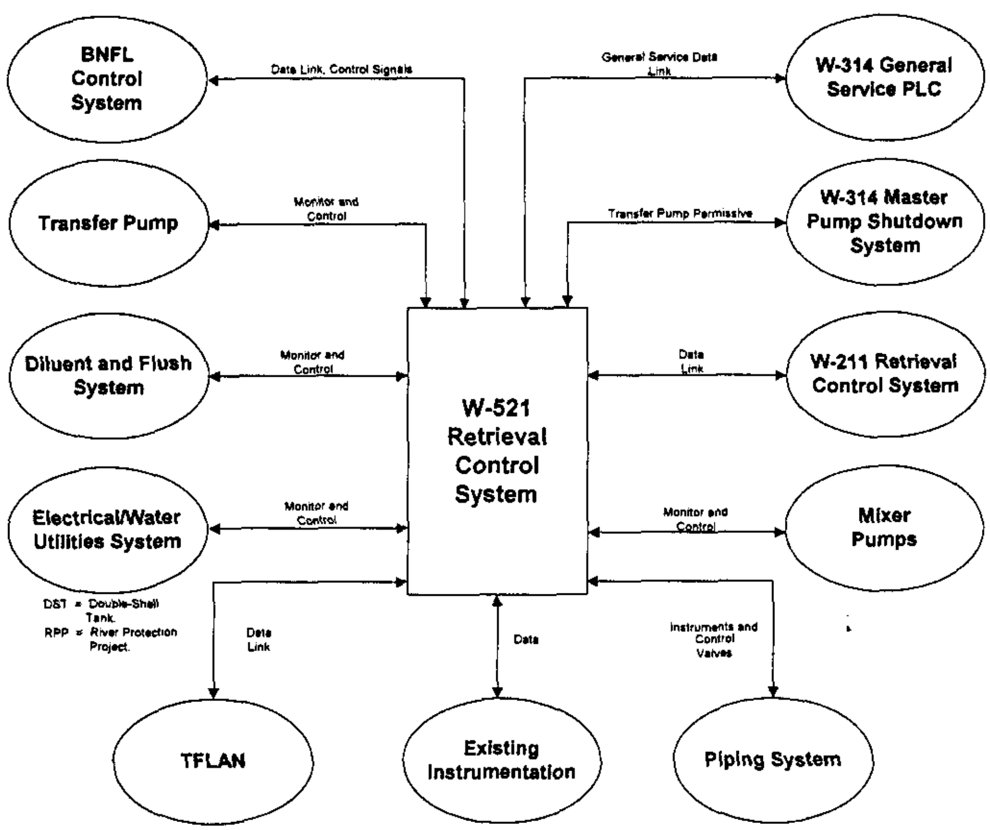

Figure 3-1. Interfaces.

3.1.3.1 WTF Interface

The requirements for the W-521/WTF interface are currently under development and are depicted in WTF-5193-ID-19 and WTF-5193-ID-20.

a. **Requirement:** WTF will have the capability to shutdown WFD transfer pumps via a hardwired interlock connected to the new MPS system.

   Basis: *Interface Control Document, WTF-5193-ID-19, Section 2.0.*

b. **Requirement:** The WFD system will have the capability to shutdown the WTF transfer pumps via a hardwired interlock connected to the WTF Control System.

   Basis: *Interface Control Document, WTF-5193-ID-19, Section 2.0.*

c. **Requirement:** Provide a data link between WFD control system and WTF control system to facilitate operation.

   Basis: *Interface Control Document, WTF-5193-ID-19, Rev. 4. TBR*

3.1.3.2 AW and SY Diluent Flush System Interface

a. **Requirement:** The DST Monitor and Control Subsystem shall monitor (receive, compare, record, display, and control) the Diluent and Flush Water System to provide local-remote integrated monitoring and control of the system at the DST Monitor and Control Subsystem operator interface station.

   Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.1.8.*

3.1.3.3 W-211 Interface

In general, there are not any requirements for the W-521 / W-211 interface specifically defined in design basis documents. The design however necessitates that these two projects interface to provide the best solution to monitor and control WFD equipment. The W-211 RCS is a sub-system of the DST Monitor and Control System. The W-211 RCS and W-521 RCS will interface via TFLAN.

The scope of the W-211 RCS is to install new systems to support retrieval activities in the following tanks:

- 241-AP-102, 104
- 241-AN-101, 102, 103, 104, 105, 107
- 241-AZ-101, 102

3.1.3.4 W-314 Interface

The W-314 MPS is a sub-system of the DST Monitor and Control System. The scope of W-314 is to replace the existing MPS system with a new PLC based system. The W-314 MPS Project plans to install a TFLAN, IEEE 802.3, fiber optic cable. The intent of the design is to provide a backbone LAN for the new MPS system and future control systems. TBR

a. **Requirement:** All SS pit leak detectors and backflow detection pressure switches will be hardwired to the new W-314 MCS system. The leak detectors installed by W-521 will be part of the MCS system.

Basis: Engineering decision to preclude safety significant software.

3.1.3.5 Tank Farm Local Area Network Interface

a. **Requirement:** Centralize remote surveillance monitoring. The W-521 RCS shall have the capability to interface with the TFLAN. Conceptual level data block transfers are defined in the W-521 Advanced conceptual Design Report design.

Basis: Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 2.0.

3.1.4 Codes, Standards, and Regulations

Table 3-1. Government Documents

Document Number	Title
DOE 5820.2A, 1988	*Radioactive Waste Management,* U.S. Department of Energy, Washington, D.C.
DOE 6430.1A, 1989	*General Design Criteria,* U.S. Department of Energy, Washington, D.C.
DOE/RL-96-109, Rev. 0	*Hanford Site Radiological Control Manual (HSRCM-1),* U.S. Department of Energy-Richland Operations Office, Richland, Washington.
RCRA, 1976	*Resource Conservation and Recovery Act of 1976, 42 USC 6901.*
10 CFR 835	Occupational Radiation Protection, Code of Federal Regulation, dated 11/98, Washington, D.C.

Table 3-2. Non-Government Documents

Document Number	Title
AASHTO, H20-44, 1996	*Standard Specification for HS-20, Highway Loading*, American Association of State Highway and Transportation Officials.
ASME B31.3, 1999	*Process Piping*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section V, 1998	*Non-Destructive Examination*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section IV	*Heating Boilers*, American Society of Mechanical Engineers, New York, New York.
ANSI Z358.1-1990	*Emergency Eyewash and Shower Equipment*, American National Standards Institute.
ASME NQA-1, 1994	*Nuclear Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP-PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP-PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP-PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP -PRO-701, Rev. 0, 1999	*Safety Analysis Process – Existing Facility.*
RPP -PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP -PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP -PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*
RPP -PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP -PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP -PRO-1819, Rev. 0, 1999	*PHMC Engineering Requirements.*
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2937, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2962, 1998	*A List of Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC) Requirements*, Numatec Hanford Corporation for Fluor Daniel Northwest for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 1A, 1999	*LMHC Administration Tank Farm Operations Equipment Labeling and Master Equipment List Control*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-MP-599, Rev. 3, 1999	*Project Hanford Quality Assurance Program Description*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TRD-007, Rev. E Draft, 1998	*System Specification for the DST System*, COGEMA Engineering for Fluor Daniel Hanford, Richland, Washington.

Document Number	Title
HNF-SD-WM-TSR-006, Rev. 0-R, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
NACE RP 0169-96, 1996	*Control of External Corrosion Engineers*, Houston, Texas.
WHC-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
WHC-SD-WM-HSP-002, Rev. 3A, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-5183, Rev. 0, 1999	Tank Farms Radiological Control Manual, Fluor Daniel Hanford, Richland, Washington.

3.1.5 Operability

a. **Requirement:** Retrieval operations will only be manned during retrieval activities. Operations shall be controlled at remote-local stations separate from the Central Monitoring Station.

Basis: Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 2.2.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

a. **Requirement**: Radiation resistance requirements shall be as defined on the Master Equipment List.

Basis: DOE Order 6430.1A.

b. **Requirement**: The subsystem components shall be designed to perform their intended function in the chemical environment defined in *Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, HNF-2937.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.5.2.1.

c. **Requirement**: Components in contact with the waste shall be designed for the 1,000 rad/h radiation environment for direct contact with tank waste as defined in *Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, HNF-2004.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.5.2.2.

3.2.2 As Low As Reasonably Achievable

a. **Requirement**: Equipment and instruments requiring personnel access for periodic calibration or maintenance shall not be located beneath cover blocks or in areas where personnel exposures are not as low as reasonably achievable (ALARA).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.4.*

b. **Requirement**: Instrument isolation valves for instrument sensor isolation and equalization shall be located outside of the primary transfer-associated structures.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.4.*

c. **Requirement**: The DST Monitor and Control Subsystem shall be designed to keep personnel exposures as low as reasonably achievable (ALARA) in accordance with *Radiological Design Review Process*, RPP-PRO-1622, and *ALARA Decision-Making Methods*, RPP-PRO-1621.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.6.1.*

3.2.3 Nuclear Criticality Safety

Nuclear criticality is not applicable to the RCS System.

3.2.4 Industrial Hazards

a. **Requirement**: The subsystem shall incorporate design features that comply with the requirements of *Tank Farms Health and Safety Plan*, HNF-SD-WM-HSP-002.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.6.1.*

b. **Requirement**: Warning and alarm systems shall be designed to ensure that they can be heard at the local noise levels of the area they are intended to cover.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.6.1.*

3.2.5 Operating Environment and Natural Phenomena

a. **Requirement**: The subsystem shall be designed for the natural environmental conditions specified in *Natural Phenomena Hazards, Hanford Site, Washington,* HNF-SD-GN-ER-501.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.5.1.*

b. **Requirement**: The subsystem shall be designed to withstand the natural phenomena hazards as specified in *Engineering Design and Evaluation*, RPP-PRO-097.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.5.1.*

c. **Requirement**: The DST Monitor and Control Subsystem and components shall be designed in accordance with safety classifications. The safety classification shall be determined using the processes described in *Safety Analysis and Technical Safety Requirements*, RPP-PRO-700; *Safety Analysis Process - Facility Change or Modification*, RPP-PRO-702; *Safety Analysis Process - New Project*, RPP-PRO-703; and *Hazard and Accident Analysis Process*, RPP-PRO-704. Preliminary safety classifications area provided for reference in Appendix B.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.6.3.*

d. **Requirement**: For requirements related to the installation of equipment in and around areas that are subject to ignition controls, see Section 3.1.1.7.d.

3.2.6 Human Interface Requirements

a. **Requirement**: All permanently installed operator interface screens shall be sized such that they are readable from a distance of 1.52 m (5 ft) [suggest a minimum 53 cm (21 in.) diagonal measurement].

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.2.*

b. **Requirement**: The physical arrangement and location of controls, displays, and alarms on control panels and HMI displays shall provide for efficient use of controls and rapid and accurate viewing of the displays and shall be in-accordance with *General Design Criteria*, DOE Order 6430.1A.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.2.*

c. **Requirement**: The subsystem shall be designed for ease of operation. Subsystem design shall comply with DOE Order 6430.1A, Section 1300.12, "Human Factors Engineering."

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.7.*

3.2.7 Specific Commitments

There are no specific commitments identified at this time.

3.3 Engineering Disciplinary Requirements

This section identifies requirements that are derived from considerations directly related to an engineering discipline.

3.3.1 Civil and Structural

a. **Requirement:** Structural Engineering will evaluate and approve mounting of control system hardware.

   Basis: *Good engineering practices.*

b. **Requirement:** The DST Monitor and Control Subsystem shall be designed to avoid damage to other components. All activities shall satisfy the tank dome loading requirements specified in HNF-SD-WM-TSR-006, Section 5.16.

   Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.6.2.*

3.3.2 Mechanical and Materials

a. **Requirement:** The construction specifications require that mechanical and material stress be considered for, instrument installations, control panels, racks, and junction boxes. In addition, it specifies that the working environment of the equipment be considered so that appropriate equipment can be selected for hazardous, wet, cold, or high heat environments.

   Basis: *DOE Order 6430.1A.*

3.3.3 Chemical and Process

This section is not applicable to the RCS, and is covered under the other SDDs.

3.3.4 Electrical Power

a. **Requirement:** The DST Electrical Power Subsystem provides 120 V ac conditioned power to the DST Monitor and Control Subsystem. The DST Monitor and Control Subsystem monitors the 480 V ac bus to provide safe shutdown of components (using an uninterruptible power supply) if a power failure occurs.

   Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.1.2.1.10.*

3.3.5 Instrumentation and Control

N/A

3.3.6 Computer Hardware and Software

a. **Requirement**: The DST Monitor and Control Subsystem design shall allow for the provision of spare or expandable input/output capability and the flexibility to change software to provide for future expansion.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.7.

b. **Requirement**: Procured software within the definitions of *Computer Software Quality Assurance Requirements*, RPP-PRO-309, shall be subject to the controls and documentation requirements listed in RPP-PRO-309, Section 2.3.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.4.

c. **Requirement**: Software generated on site and within the definitions of RPP-PRO-309 shall be developed, verified and validated, meet the documentation requirements and be under the configuration management controls of RPP-PRO-309.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.4.

d. **Requirement**: Design verification shall be performed on the DST Monitor and Control Subsystem, as represented in design drawings, prototypes, engineering models, etc., for the purposes of verifying that the design meets the requirements of this specification. Design verification is subject to the procedure identified in *Engineering Requirements*, RPP-PRO-1819, Section 2.5.1.

Basis: Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 4.2.

3.3.7 Fire Protection

This section is not applicable to the RCS.

3.4 Testing and Maintenance Requirements

3.4.1 Testability

a. **Requirement**: All testing of equipment and instruments shall have the ability to be performed without having to have personnel access pits (other than with video cameras for leak tests) or without having to remove any equipment from the pit. Leak detectors and valve position indicators will be designed and installed to maintain remote testing capabilities. This is important from an ALARA standpoint and from a time to perform the task standpoint. Required tests must be able to be performed within their specified periodicity without impacting Waste Feed Delivery operations. This can only be accomplished by *not* having to remove the equipment and *not* having to perform pit entries.

Basis: *This requirement is per HNF-4553, Operations and Maintenance Philosophy, Section 7.4.*

b. **Requirement:** Leak detectors shall be capable of being functionally tested.

Basis: *Double-Shell Tank Transfer Piping Subsystem Specification, HNF-4161, Rev. 0, Section 3.5.1.d.*

3.4.2 Technical Safety Requirement-Required Surveillances

a. **Requirement:** SR 3.1.3.1 (Perform FUNCTIONAL TEST on conductivity probe transfer leak detection systems) – Once within 92 days prior to removing an administrative lock from a PHYSICALLY CONNECTED WASTE transfer pump AND once per 92 days thereafter. This SR applies if the requirement to monitor transfer line encasements for leakage during a transfer becomes a requirement of the RPP Authorization Basis.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, *Tank Waste Remediation System Technical Safety Requirements*, Section 3.0.

3.4.3 Non-TSR Inspections and Testing

N/A

3.4.4 Maintenance

a. **Requirement:** To the extent practical, RCS design shall be standardized to facilitate operations and maintenance.

Basis: *Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 1.4.*

b. **Requirement:** The maintainability guidance provided in *Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities*, UCRL 15673, shall be considered during subsystem design.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.4.*

c. **Requirement:** Equipment and instruments requiring personnel access for periodic calibration or maintenance shall not be located beneath cover blocks or in areas where personnel exposures are not as low as reasonably achievable (ALARA).

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.4.*

d. **Requirement**: Instrument isolation valves for instrument sensor isolation and equalization shall be located outside of the primary transfer-associated structures.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.2.4.*

e. **Requirement**: Instrument components external to transfer-associated structures shall be designed for minimal contact maintenance and hands-on operation.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.5.1.*

f. **Requirement**: All components requiring maintenance, calibration, or hands-on operation shall be located external to the pits. Transmitters for the liquid level, flow, and pressure shall be located external to the pits.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.5.1.*

3.5 Other Requirements

N/A

3.5.1 Security and Special Nuclear Material Protection

a. **Requirement:** Operator interface station and engineering workstations must maintain personnel access software so that the system will only allow certain log-in groups to perform the desired functions.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.9.*

3.5.2 Special Installation Requirements

N/A

3.5.3 Reliability, Availability, and Preferred Failure Modes

a. **Requirement**: Instrumentation installed in Tank Farms systems will be exposed to high levels of radiation, caustic chemicals, extreme temperature ranges, and a wide range of elements and conditions. These instruments should be standardized, rugged and have a history of proven performance with minimal maintenance.

Basis: *Operations and Maintenance Philosophy, HNF-4553, Rev. 0, Section 5.2.*

3.5.4 Quality Assurance

Quality Assurance requirements are identified in the Master Equipment List.

3.5.5 Miscellaneous

a. **Requirement:** The subsystem shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in *RPP Administration,* "Tank Farm Operations Equipment Labeling," HNF-IP-0842, Volume II, Section 6.1. Equipment identifiers within the HMI interface screens shall be consistent with the equipment label in the field.

Basis: *Double-Shell Tank Monitor and Control Subsystem Specification, HNF-4155, Rev 1, (DRAFT), Section 3.3.3.*

4.0 SYSTEM DESCRIPTION

The system description and operations presented in this section discuss those system features that satisfy the requirements of the WFD system.

The configuration information section describes the RCS and the associated major components, boundaries and interfaces, physical location and layout, principles of operation, and reliability and control features.

4.1 Configuration Information

4.1.1 Description of System, Subsystems, and Major Components

4.1.1.1 Human Machine Interface

The HMI will be an industrial personal computer running a graphical interface program. The HMI will contain graphical displays and control panels to monitor and control retrieval activities.

4.1.1.2 PLC

The PLC and PLC program will be modularized to facilitate modifications and retesting efforts.

4.1.1.3 TFLAN

The W-521 RCS will interface with the TFLAN.

The TFLAN is planned to provide a high degree of flexibility to the DST Monitor and Control System. The W-521 RCS will have the capability to display all data that is available on TFLAN.

The W-521 AY and AZ annulus ventilation PLCs, installed to support ventilation upgrades, will interface with TFLAN.

4.1.1.4 Instrumentation

The instrumentation to support the WFD system is listed below. The detailed description of the instrumentation will be completed in detailed design.

- Mag Flowmeter
- Multi-variable Meter (density, flow, and temperature)
- Pressure Switches
- Pressure Transmitter
- Valve Limit Switches
- Vibration Monitors
- Temperature Elements
- Temperature Transmitters
- Level Switches
- Motor Operated Valves (MOVs)
- Control Valves
- Control Panels
- Pressure Regulators
- Leak Detectors
- Closed Circuit Television (CCTV)
- CCTV Purge Controls
- Standard Hydrogen Monitoring System – E+, contact to indicate high hydrogen in stack 296-A-42
- Replacement sample probe (nozzle) for existing 296-A-42 stack radionuclide monitor. Note that the rest of the existing monitor meets the requirements of section 3.1.1.8

4.1.1.5 CCTV

The preferred or recommended alternative for applications longer than three weeks per year is the 4-in. permanent camera system. For applications shorter than three weeks per year, the 4-in. MCCS is the recommended system. Both of these systems have identified problems that should be addressed by the maintenance organization as necessary. It may be beneficial to prepare a specification for competitive bid where the proposals of two or more companies are assessed against the requirements. Any claimed improvements must be clearly demonstrated by rigorous testing prior to installation in the tanks. However, this may ultimately be a more costly approach than continuing to work with the current vendor to make needed improvements, which should also be demonstrated by rigorous testing.

It should also be noted, that although the 12-in. permanent camera was not evaluated further because it did not meet the requirement for use in a 4-in. riser, there may be occasions when this system can be used. The 12-in. permanent camera has initial and maintenance costs that are very close to those of the 4-in. permanent camera system, and the system is somewhat more robust. The pan-and-tilt mechanism is more durable, and the lighting system can provide greater illumination to see across the tank. This system would be preferred in any instance where the 4-in. permanent camera is favored over the 4-in. MCCS, and a 12-in. riser is readily available in a location for appropriate in-tank viewing.

4.1.1.6 Leak Detectors

During transfer of tank waste, transfer-associated structures are monitored for leakage from valve manifolds, jumpers, piping nozzles, and transfer piping encasements by a leak detection system. The pit leak detection system transmits alarm signals the MPS System.

Low point leak detectors (conductivity probes) are permanently mounted in the lowest part of the pit floor. The conductivity probes have electrodes at different electrical potentials that are short-circuited by a conductive medium (i.e., liquid waste) and cause a change in state of the monitoring circuitry. When the liquid waste short-circuits the leak detector electrodes, an alarm is generated, and associated Instrumentation and Control System interlock circuitry is actuated to trip the transfer pump.

Continuous encasement leak detector cables will be installed in the encasement piping between AP-A valve pit and the WTF. The sensors and cables will be designed to withstand the effects of a radioactive liquid. The leak detector control panels will be located in the 271 AP annex.

The preferred method is to wire all leak detector signals to the MPS system. Pit leak detectors will be hardwired to the MPS system SS PLCs. Encasement leak detectors will be connected to the MPS system GS PLCs or to the RCS PLC, and leak detector signals will be data linked to MPS system.

4.1.2 Boundaries and Interfaces

4.1.2.1 WTF Interface

The requirements for the W-521/WTF interface are depicted in WTF-5193-ID-19.

Shutdown and leak detection signals will be hardwired from the W-521/WTF interface terminal box to the new MPS system located in the new AP annex.

WTF will provide two sets of redundant dry contacts to the W-314 MPS system. One redundant set of contacts will be used to shut down the WFD transfer pump. The second set of redundant contacts will be used to indicate a leak within the WTF facility; i.e., "high sump level."

W-314 MPS system will provide two sets of redundant dry contacts to the WTF. One redundant set of contacts will be used to shutdown the WTF pump (used to send waste back to DSTs). The second set of redundant contacts will be used to indicate a leak associated with the WFD system; i.e., 'Pit AP-A Leak'.

The interface point for these hardwired signals will be at the terminal box provided by W-521.

In addition to the hardwired signals, a data link will be installed between the WTF and the new MPS system.

The WTF and the DST Monitor and Control System will communicate necessary data over a data link to facilitate operations. The physical media is shielded twisted pair. There are several options for an acceptable protocol between systems. Making changes in program instructions easily modifies the data block.

4.1.2.2 Diluent and Flush Systems

The Diluent and Flush System will be specified with stand-alone PLC based controls with capability for local monitor and control. The W-521 RCS will interface with the Diluent and Flush control system via a data link, and will have the capability to execute all normal monitor and control functions from the local-remote HMI.

The data communicated over the peer to peer link between the diluent and flush PLC and RCS is defined below:

- Diluent Pump On
- Diluent Pump Off
- Diluent Pump Speed
- Diluent Pump Motor Current
- Diluent Pump Discharge Pressure
- Diluent Pump Discharge Flowrate
- Diluent Pump Discharge Temperature
- Diluent Valve Position Switches (Open/Close or A, B, C)
- Diluent Flow Valve Position
- Diluent Tank Level
- Diluent Tank Level Switch High
- Diluent Tank Level Switch Low
- Diluent Tank Temperature
- Diluent Tank Conductivity
- Caustic Metering Pump Status
- Caustic Metering Pump Flowrate
- Sump Level Switch High
- Heated Raw Water Flowrate

- Heated Raw Water Valve Position
- Raw Water Flow Valve Position
- Boiler or Heater Status
- Boiler or Heater Input Water Temperature
- Boiler or Heater Output Water Temperature
- Boiler or Heater Fault; i.e., 'Low Water Flow'

Outputs:

- Discrete Valve Position (Open/Close or A, B, C)
- Diluent Flow Control Valve Position
- Diluent Pump Speed
- Diluent Re-circulation Pump Start/Stop
- Metering Pump Flow Set-Point
- Heated Water Flow Control Valve
- Boiler or Heater Temperature Set-point

4.1.2.3 W-211 Interface

Projects W-521 and W-211 control systems will interface at the TFLAN/HMI level. Diluent and Flush monitor and control functions will be required at each tank farm that requires diluent and/or flush water.

4.1.2.4 W-314 Interface

Pit leak detectors and backflow detection pressure switches installed by project W-521 will be connected (hardwired) to the W-314 MPS System.

W-521 will install a new pit leak detector in the existing AP valve pit and the new AP-A valve pit. Backflow detection pressure switches will be installed in valve pit SY-A, AW-A, AW-B, and pump pits AW02A, AY01A and AY02A.

Valve position switches in AP-A valve pit and the existing AP valve pit will be connected (hardwired) to new MPS system GS PLC located in AP 271 annex.

New valve position switches and encasement leak detectors will be installed by W-521 in the SY-A and SY-B pits, and will be wired to the W-521 RCS and a data link will provide valve status and encasement leak detector status to the MPS System. All programming and testing of software will be completed under W-521 Scope or Work.

A continuous leak detector will be installed in the encasement piping between the new AP-A valve pit and the WTF (4 lines). The continuous leak detector will monitor the complete run of encased piping from valve pit AP-A to the low point located in WTF facility. The leak detector control panel will be located in AP 271 annex and output signals will be wired to the MPS system GS PLC. All programming and testing of software will be completed under W-314 Scope or Work.

A data link will be provided to W-314 MPS system GS from the WTF Control System. The data link media is shielded twisted pair.

4.1.2.5 TFLAN Interface

Project W-314 is currently designing a GS TFLAN to be used as a backbone communication system for the new MPS system and WFD projects. All data from the W-521 RCS will be sent over the TFLAN to a central monitor and control station.

Project W-521 will extend TFLAN to new W-521-supplied ICE buildings. Project W-521 will also connect AY and AZ annulus ventilation PLCs to TFLAN.

TFLAN is a fiberoptic cable (IEEE 802.3 Ethernet). TBR

4.1.3 Physical Location and Layout

Reference W-521 Site Development Plan.

4.1.4 Principles of Operation

4.1.4.1 Mixer Pump and Transfer Pump

The mixer and transfer pumps will be operated from the local-remote HMI. The pumps are capable of being shut-down manually from the local-remote location. The local-remote HMI shall be stand-alone (capable of running WFD operations without the TFLAN connection). Instrumentation signals that are necessary for WFD operations will be hardwired into the W-521 RCS. These signals will be sent over TFLAN for central monitor functions.

4.1.4.2 Diluent and Flush Systems

The Diluent and Flush System will be capable of local, or local-remote operation. Startup will be completed locally, and continued monitor and control functions will be conducted from the local-remote HMI located in the ICE Buildings.

4.1.5 System Reliability Features

Instrumentation should be standardized, rugged, and have a history of proven performance that requires a minimum amount of maintenance.

4.1.6 System Control Features

This system does not contain any unique control features.

4.2 Operations

4.2.1 Initial Configurations (Pre-startup)

4.2.1.1 Verify Transfer Component Status

Under normal conditions, the RCS and associated monitor and control systems shall be functional prior to starting WFD operations.

4.2.1.2 Verify Transfer Route

A permissive from MPS system is interlocked with RCS, when valve positions match transfer route. The RCS is responsible for monitoring the position of the waste valves located in the pump pits.

4.2.2 System Startup

The transfer or mixer pump will be started from the local-remote station. Manual transfer switches will be used to select the mixer or transfer pump for operation.

Also, a permissive from the new MPS system is required.

4.2.3 Normal Operations

4.2.3.1 Mixer Pump Monitor and Control

The mixer pump operation should be monitored and controlled from the local-remote HMI to ensure that the waste is being effectively mobilized. The command from the W-521 RCS shall include but not be limited to Start, Stop, and Frequency. The feedback from the VFD to the W-521 RCS shall be Start, Stop, Frequency, amps, voltage, and protective trip faults. The PLC will calculate the pump speed based on frequency feedback.

- The RCS will monitor the pump column water pressure.
- The RCS will monitor and control mixer pump speed.
- The RCS will monitor and control mixer pump seal water flow.
- The RCS will monitor the differential pressure across the pump column supply filter.
- The RCS will monitor the motor bearing temperature, vibration, and winding temperature.
- The RCS will monitor and control the mixer pump oscillation via a data link connected to the VFD.
- Further detail TBD.

Local-remote station will be manned during WFD operations. Monitoring functions will also take place at a central monitoring location.

4.2.3.2 Transfer Pump Monitor and Control

The monitor and control system will be designed to support the process outlined below from the local-remote HMI.

- Precondition the transfer line. This step requires that the transfer pipe temperature be raised so that waste temperature is maintained within an acceptable window.
- The RCS shall have the capability to add diluent to the transfer pump suction during a transfer.
- Prior to and during a transfer the RCS shall be capable of the following:
  - Position the transfer pump inlet. The CCTV will be used to verify that the variable pump suction is functioning properly.
  - Monitor the position of the transfer pump inlet.
  - Monitor transfer pump parameters.
  - Monitor process waste parameters.
  - Monitor the supply tank parameters.
  - Monitor the receiving tank parameters.
- Monitor the transfer system for waste leaks and/or misrouting.
- The RCS shall have the capability to flush the transfer line.
- The RCS shall have the capability to drain the transfer line.
- The RCS shall have the capability to provide the appropriate data to complete a material balance.
- Establish a new transfer route, W-314 Scope:
  - A permissive from MPS system is interlocked with RCS, when valve positions match transfer route.

The RCS will monitor and control the transfer pump operation. The transfer pump operation should be monitored to ensure that the waste is being effectively mobilized.

The RCS will monitor the discharge flow rate, pressure, density, and temperature.

The command from the W-521 RCS shall include but not be limited to Start, Stop, and Frequency. The feedback from the VFD to the W-521 RCS shall be Start, Stop, Frequency, amps, voltage, and protective trip faults. The PLC will calculate the pump speed based on frequency feedback.

The RCS will monitor the motor bearing temperature, vibration, and winding temperature.

The tank waste level is monitored prior to and during a waste transfer.

4.2.3.3 Monitor and Control In-Line Dilutions

The RCS will control the diluent flow rate, temperature, and total flow. The diluent system will deliver diluent to the transfer pump suction. The RCS will operate the system in recirculation or transfer mode as required. The RCS will also have the capability to back flush back through the pump.

Process control of the in-line diluent additions will be provided by equipment and instrumentation at the Diluent and Flush System as well as at the pump pit. Diluent flow will be monitored and controlled as required, as well as diluent temperature and line pressure. The caustic addition supply line pressure will be monitored and compared to the pump discharge line to prevent any backflow through the supply line. Detection of high pressure in the supply line is required to actuate an alarm an/or provide an interlock to shut the transfer pump. The pressure set point shall be 15 +/- 3 psig.

4.2.3.4 Diluent System Operation

- The RCS will monitor and control the diluent flow rate.
- The RCS will monitor and control the total diluent flow rate added.
- The RCS will monitor and control the diluent temperature.
- The RCS will control the diluent concentration.
- The RCS will monitor and control the pre-conditioning and flushing of transfer lines.
- The RCS will monitor additional parameters as identified in the interface section of this preliminary SDD.

4.2.4 Off-Normal Operations

Abnormal conditions are alarmed at the local-remote station, and the central monitor station.

All alarms and interlocks will be designed in future design efforts.

The 296-A-42 stack radionuclide monitor will alarm in the event of high beta/gamma readings. The 296-A-42 SHMS E+ will alarm in the event of high flammable gas measurements.

4.2.5 System Shutdown

All alarms and interlocks will be designed in future design efforts. All interlocks will be generated directly from the PLC logic. The 296-A-42 ventilation fans will be shutdown in the event of a high stack beta/gamma alarm.

4.2.6 Safety Management Programs and Administrative Controls

Control system should be designed to facilitate changes or modifications and functional checkout activities to support the WFD mission. This is to include but not be limited to fully documented software and an operations program to include configuration/software management of change.

4.3 Testing and Maintenance

Instrumentation will be designed to facilitate periodic testing and calibration, and should not require entry into tank or pit.

All software changes will be managed per HNF-PRO-309.

4.3.1 Temporary Configurations

This section is not applicable to the RCS at this time.

4.3.2 TSR-Required Surveillances

There are no new TSR-required surveillances identified at this time.

4.3.3 Non-TSR Inspections, and Testing

N/A

4.3.4 Maintenance

The W-521 RCS will be designed to facilitate maintenance activities.

PIPING, JUMPER, AND VALVE SYSTEM DESIGN DESCRIPTION

prepared for

CH2M HILL HANFORD GROUP, INC.

Contract No. 4412, Task 00008
Report No. W-521-SDD-05
Revision 2

September 2000

Prepared by: Tom Salzano, P.E.

Approved by: RLFritz
Robert L. Fritz

Date: 9-29-00

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Acronyms

AC	Administrative Controls
ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
DOE	U.S. Department of Energy
DST	Double-Shell Tank
ECN	Engineering Change Notice
FSAR	Final Safety Analysis Report
GS	General Service
HNF	Hanford Nuclear Facility
RPP-PRO	Project Hanford Management Contract Procedure
ICS	Industrial Controls and Systems
LCO	Limited Conditions for Operation
MEL	Master Equipment List
MPS	Master Pump Shutdown
NEMA	National Electrical Manufacturers Association
NUREG	U.S. Nuclear Regulatory Commission
ORP	Office of River Protection
PUREX	Plutonium-Uranium Extraction
RPP	River Protection Project
SC	Safety Class
SDD	System Design Description
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To be determined
TBR	to be refined
TSR	Technical Safety Requirements
TWRS	Tank Waste Remediation System
UL	Underwriters Laboratories
WAC	Washington Administration Code
WFD	Waste Feed Delivery
WFDS	Waste Feed Delivery System
WTF	Waste Treatment Facility

1.0 INTRODUCTION

This System Design Description (SDD) identifies performance requirements, defines bases, and provides references to requisite codes and standards for the Waste Feed Delivery System (WFDS) Project W-521 Piping, Jumper, and Valve System. This SDD addresses only the piping, jumpers, and valves contained in transfer-associated structures. New buried piping is addressed in the RPP/Waste Treatment Facility (WTF) Transfer Piping SDD (ref. W-521-SDD-06). It also identifies the system configuration to the extent defined by the conceptual design.

1.1 System Identification

The Piping, Jumper, and Valve System is comprised of the following major subsystems:

- Valve Manifolds/Jumpers,
- In-Line Sensors*,
- DST Addition Drop Legs.

*Only sub-functions of the In-Line Sensors system are allocated to the Piping, Jumper, and Valve System (see Section 2.1).

1.2 Limitations of this SDD

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary, or of a highly conceptual nature. This SDD will be a living document throughout the design phases of W-521, and will become more detailed as the design progresses through Definitive Design. Requirements were taken from HNF-4160, *Piping, Jumper, and Valve System Specification,* Rev. 0. The previous revision was based on the Draft Level 2 Specifications.

1.3 Ownership

This SDD is owned by the Project Engineer responsible for the Piping, Jumper, and Valve System.

1.4 Definitions

Active – An active component is one that is part of the "as-built" tank farms and has not been isolated and disconnected from all other tank farm components as part of an approved Engineering Change Notice (ECN).

Ex-Tank Intrusive – The ex-tank intrusive region includes pits (e.g., transfer-associated structures) that are not isolated from the tank dome space by a seal barrier. The ex-tank intrusive region also includes the area around tank openings that are directly connected to the dome space, to the closest of eighteen 4.92-m (15-ft) opening diameters or the boundary of temporary containment devices, whichever distance is less.

General Service (GS) SSC – Structures, systems, or components (SSCs) not classified as either Safety Class or Safety Significant.

Manifold – Remotely installed rigid piping system inside a pit that transfers waste and flush water between nozzles.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

  - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
  - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
  - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
  - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
  - Two Safety – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

  (**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

Pit Nozzle – Rigid male connector anchored in the pit wall or the transfer pump housing that provides a leak-tight connection with the integral seal block attached to a manifold.

RPP Design Authority – A person qualified in the practice of engineering with four years demonstrated job related experience including two years in their specific functional areas. For nuclear structures, systems, or components, they shall have at least one year nuclear experience. The RPP Design Authorities for the facility and for the Project must have completed the RPP Design Authority Qualification Card and have an appointment letter approved by the RPP Chief Engineer.

Safety Class (SC) SSC – An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant (SS) SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall – Denotes a requirement.

Shall Consider – Requires that an objective assessment be performed to determine to what extent the specific factor, criterion, guideline, standard, etc., will be incorporated into or satisfied by the design. The results and basis of this assessment shall be documented. Such documentation shall be retrievable and can be in the form of engineering studies, meeting minutes, reports, internal memoranda, etc.

Should – Denotes a recommendation. If a "should" requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

Tank Opening – Tank risers and pits with an open path to the tank.

TBD – To be determined. A study and/or calculation need to be performed in order to provide a sufficient technical basis for the requirement.

TBR – To be refined. A "soft" basis for the requirement has been identified. However, a further study and/or calculation need to be performed in order to solidify the requirement's technical basis.

Transfer-Associated Structure – Pump pits, valve pits, diversion boxes, or cleanout boxes.

Waste Feed – Waste slurry to be transferred to the WTF containing a mixture of solids and liquids.

2.0 GENERAL OVERVIEW

2.1 System Functions

The overall mission of the Piping, Jumper, and Valve System is to reliably establish the transfer route for delivering waste feed to the treatment and immobilization facilities. To accomplish this mission, the Piping, Jumper, and Valve System must meet the requirements of the following functions:

- Position Valves for Transfer,
- Measure Valve Position (sub function of Monitor Valve Position*),
- Direct Waste Additions Within DSTs,
- Confine Waste Within Valve Manifolds and Jumpers,
- Confine Caustic and Diluent Within Valve Manifolds and Jumpers,
- Position Recirculation Valve,
- Measure Waste Transfer Flow, Pressure, (including service water pressure detection) and Density (sub function of Monitor Process Parameters*),
- Confine Flush Water Through Valve Manifolds and Jumpers, and
- Position Valves for Offline Service.

*The remainder of the sub-functions associated with these functions are allocated to the DST Monitoring and Retrieval Control System (ref. W-521-SDD-04).

2.2 System Classification

Table 2-1 identifies the preliminary safety classification of piping, jumper, and valve system components as stated in HNF-SD-WM-SAR-067, ECN 650166, Tank Waste Remediation System (TWRS) Final Safety Analysis Report (FSAR).

Table 2-1. Preliminary Safety Classification of Piping, Jumper, and Valve System Components

Component	GS	SS
Valve Manifolds and Jumper	X	
DST Addition Drop-Legs	X	
Service Water Pressure Switch Interlock or Alarm	X	X(1)
Isolation Valves		X

(1) The pressure elements located in the cross-tie between the waste transfer manifold and the flush/diluent manifold are safety significant
GS = general service.
SS = safety significant.

2.3 Basic Operational Overview

The following discussion provides a brief overview of the functions of the sub-elements of the Piping, Jumper, and Valve System.

- The valve manifolds and jumpers provide a confined routing path for the transfer of tank waste among storage locations and for routing caustic/diluent and flush water. Figure 2-1 shows a typical jumper arrangement.
- The DST Addition Drop-Legs route the waste or caustic/diluent into the tank through a riser.
- Temperature, pressure, density, and flow elements are located on valve manifolds in the transfer-associated structures. Dual pressure elements are used to protect the service water distribution system. Valve position indicators provide a positive indication of valve line-up positions.

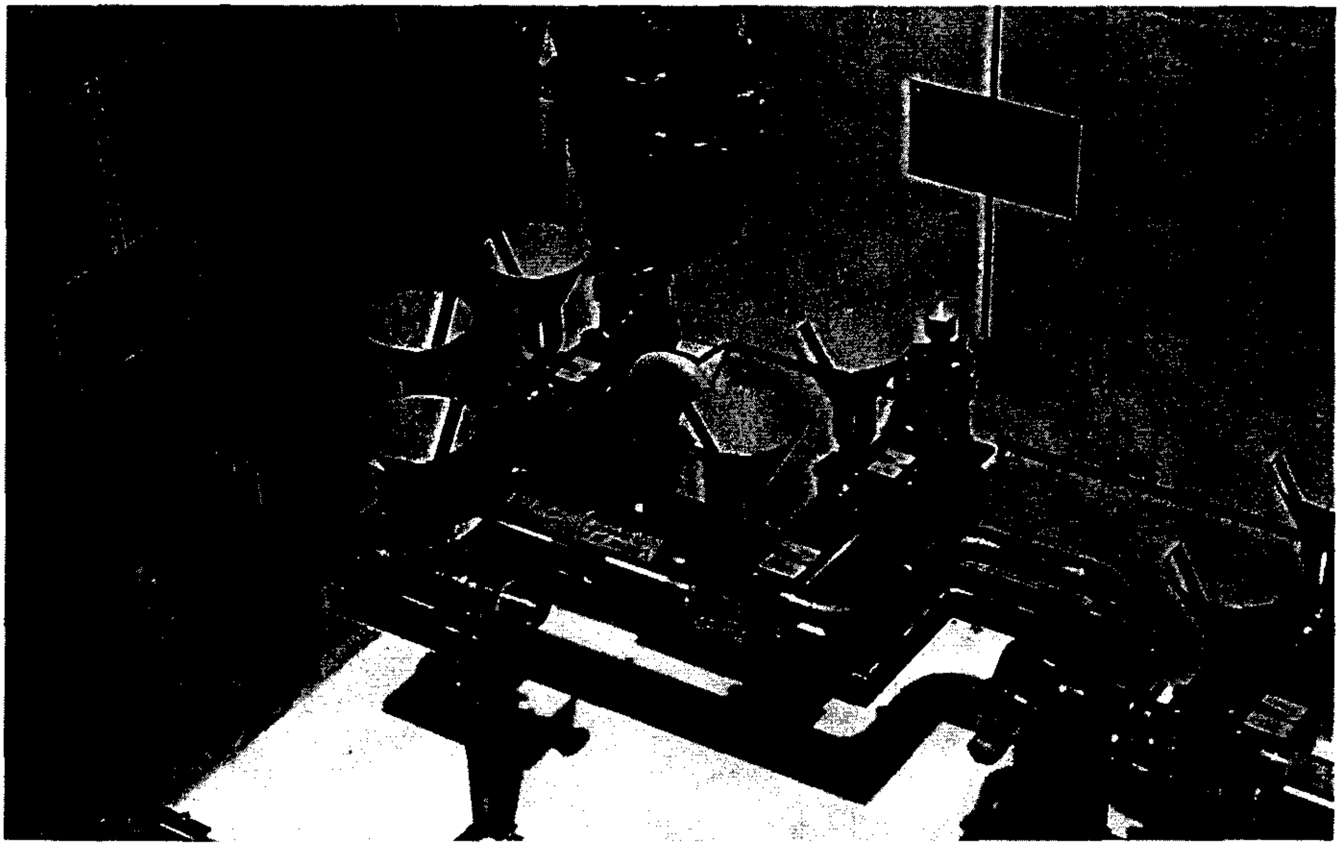

Figure 2-1. Typical Jumper Arrangement

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section identifies the general requirements for the Piping, Jumper, and Valve System and the bases for these requirements.

3.1.1 System Functional Requirements

a. **Requirement:** The Piping, Jumper, and Valve System shall enable or block waste flow from required ports to achieve routing objectives.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.1.

b. **Requirement:** The Piping, Jumper, and Valve System shall provide local indication of the actual position of all transfer valves.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.2.

c. **Requirement:** The Piping, Jumper, and Valve System shall include measurement devices to provide an electronic signal that indicates the position status of transfer valves.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.2.2.

d. **Requirement:** The Piping, Jumper, and Valve System shall provide DST addition drop-legs to direct waste, service water, or diluent into DSTs.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.3.

e. **Requirement:** The transfer valve manifolds and jumpers shall provide the primary containment boundary for waste routed through the pump and valve pits.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.4.

f. **Requirement:** The Piping, Jumper, and Valve System shall be capable of routing diluent and flush water to the transfer pump suction or transfer pump discharge through fixed jumpers or valve manifolds. The Piping, Jumper, and Valve System also shall route diluent and flush water to the DST addition drop-leg in the tank riser for direct addition to the DST via fixed manifolds or jumpers. The Piping, Jumper, and Valve System also shall be capable of routing filtered raw water from the DST Raw Water Subsystem to the tank.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.5.*

g. **Requirement:** The transfer valves shall enable or block flow to achieve recirculation from the transfer pump to the tank.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.6.*

h. **Requirement:** The Piping, Jumper, and Valve System shall provide the capability to measure the waste flow rate at the transfer pump discharge.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.7.1.*

i. **Requirement:** The Piping, Jumper, and Valve System shall provide the capability to measure transfer pump discharge pressure.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.7.2.*

j. **Requirement:** The Piping, Jumper, and Valve System shall provide the capability to measure waste density at the transfer pump discharge.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.7.4.*

k. **Requirement:** The Piping, Jumper, and Valve System shall be capable of being gravity drained to the source or receiving tank.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.11.*

l. **Requirement:** The transfer valves shall enable or block flow to provide offline service of water, diluent, and water transfers.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.12.*

m. **Requirement:** The transfer valves shall enable or block flow to achieve flushing objectives for jumpers, transfer, piping, and transfer pumps.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.13.*

n. **Requirement:** The Piping, Jumper, and Valve System shall be capable of detecting any backflow of waste or contaminated flush or diluent from the transfer pump to the flush/diluent jumper.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.14.

o. **Requirement:** The Piping, Jumper, and Valve System shall be capable of preventing any backflow of waste or contaminated flush or diluent from the transfer pump to the flush/diluent jumper.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.15.

p. **Requirement:** The Piping, Jumper, and Valve System shall restrict leakage of the RPP/WTF Transfer Piping secondary confinement drain piping.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.16.

3.1.2 Subsystem and Major Components

3.1.2.1 Valve Manifolds/Jumpers

a. **Requirement:** The valves shall remain closed when within 5 degrees of full closed position.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.1.a.

b. **Requirement:** Mechanical (local) position indication for valves shall be accurate to within ± 5 degrees with respect to the actual valve position.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.2.1.a.

c. **Requirement:** Mechanical (local) indication of the valve's position shall be visible from the top of the cover block.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.2.1.b.

d. **Requirement:** The Piping, Jumper, and Valve System shall be designed to transfer waste up to 160 gal/min (606 L/min).

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.4.a.*

e. **Requirement:** Pressure boundaries shall be designed for no visible leakage at test pressure in accordance with ASME B31.3.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.4.b.*

f. **Requirement:** The design pressure of new Piping, Jumper, and Valve System components shall be 450 lb/in^2 (3103 kPa) gauge (TBR).

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.4c, as modified per Design Authority direction.*

g. **Requirement:** The Piping, Jumper, and Valve System shall be designed to transfer and route diluent/flush water at a flow rate up to 160 gal/min (606L/min).

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.5.a.*

h. **Requirement:** The Piping, Jumper, and Valve System shall be designed to transfer and route filtered raw water at a pressure not to exceed the transfer waste design pressure defined above.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.5.b.*

i. **Requirement:** The valves shall be capable of being positioned in the full-open or full-closed positions for every port. The valve position is defined as fully closed and seated in Section 3.2.1.1.a.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Sections 3.2.1.6.a, 3.2.1.12.a, and 3.2.1.13.a.*

j. **Requirement:** A vacuum break release shall be provided for the transfer piping to allow gravity liquid draining.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.11.*

k. **Requirement:** Piping, Jumper, and Valve System designs shall provide for ease of cut-up, dismantling, removal, and packaging of contaminated equipment (e.g., removal and packaging of components within transfer-associated structures) from the facility.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.8.*

l. **Requirement:** Piping shall be designed and fabricated to minimize crud traps.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.8.*

m. **Requirement:** Isolation valves for waste transfer branch lines, diluent addition lines, and service water flush lines shall be located as close to the main transfer line as practical.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.8.d.*

3.1.2.2 In-Line Sensors

a. **Requirement:** The flow rate measurement device shall be capable of measuring a range of 0-200 gal/min (0-757 L/min) with an accuracy of 0.5 percent of range <TBR>.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.7.1.a.*

b. **Requirement:** The pressure measurement device(s) shall be capable of measuring a range of 0-850 lbf/in^2 (0-5960 kPa) with an accuracy of 0.5 percent of range <TBR>.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.7.2.a.*

c. **Requirement:** The density measurement device shall be capable of measuring a range of 0.9 to 1.5 g/cm^3 with an accuracy of 0.0005 g/cm^3 <TBR>.

Basis: *These requirements are per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.7.4.a.*

d. **Requirement:** The detection instrumentation shall be compatible with the requirements of the Retrieval Control System Design Description. The detection instrumentation shall be installed between the pump discharge and the backflow prevention device required below.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.14.a.*

e. **Requirement:** The backflow prevention device shall be compatible with the requirements for jumpers and jumper components. The backflow prevention device shall be installed between the flush/diluent supply and the backflow prevention instrumentation required above.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.15.a.*

3.1.3 Boundaries and Interfaces

Subsystems that interface with the Piping, Jumper, and Valve System are the Transfer Pump System; the RPP/WTF Piping Systems; the Valve/Pump Pits Cover Blocks System; the Electrical/Water Utilities System; the Diluent and Flush System; the Retrieval Control System, and the existing DST Confinement and Transfer Piping Systems. These interface relationships are illustrated in Figure 3-1.

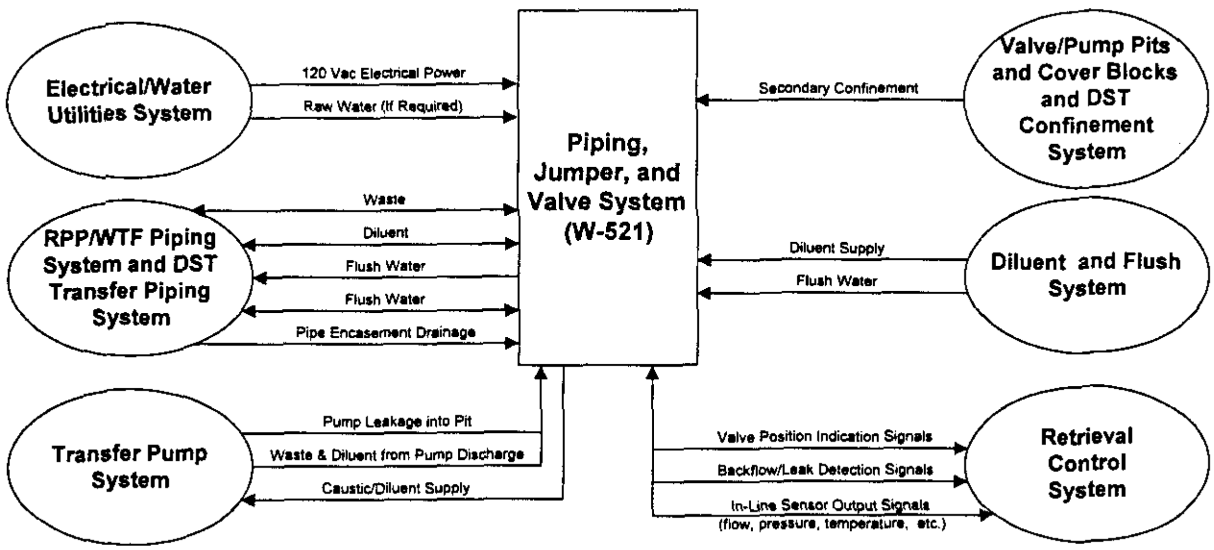

Figure 3-1. Piping, Jumper, and Valve System Interfaces

3.1.3.1 Transfer Pump System

a. **Requirement:** The Piping, Jumper, and Valve System shall transfer and route the waste or diluent from the Transfer Pump System at a pressure not to exceed the design pressure defined in Section 3.1.2.1.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.1.a.*

3.1.3.2 RPP/WTF Piping System

a. **Requirement:** The Piping, Jumper, and Valve System shall route the waste, diluent, and filtered raw water from the Transfer Pump System at a pressure not to exceed the design pressure defined in Section 3.1.2.1.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.2.a.

b. **Requirement:** The Piping, Jumper, and Valve System shall provide a seal loop jumper to block and route the flow of waste, diluent, or water from the Transfer Piping System secondary confinement drain.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.2.b.

3.1.3.3 Valve/Pump Pits and Cover Blocks

a. **Requirement:** The Valve/Pump Pits and Cover Blocks System shall provide the secondary confinement of the Piping, Jumper, and Valve System.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.1.

3.1.3.4 Electrical/Water Utilities System

a. **Requirement:** The Piping, Jumper, and Valve System shall route the filtered raw water from the Raw Water Subsystem at a pressure not to exceed the design pressure defined in Section 3.1.2.1.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.3.a.

b. **Requirement:** The Electrical/Water Utilities System shall provide 120 VAC, single-phase electric power to the Piping, Jumper, and Valve System.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.4.

3.1.3.5 Diluent and Flush System

a. **Requirement:** The Piping, Jumper, and Valve System shall transfer and route the flush or diluent from the Diluent and Flush System at a pressure not to exceed the design pressure defined in Section 3.1.2.1.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.6.a.*

3.1.3.6 DST Monitoring and Retrieval Control Subsystem

a. **Requirement:** The Piping, Jumper, and Valve System shall be designed using motor-operated valves when required.

   Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.1.2.1.8.a.*

b. **Requirement:** Measurement device(s) for remote indication of valve position shall be compatible with the requirements of the Retrieval Control System.

   Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.2.2.a.*

c. **Requirement:** The Piping, Jumper, and Valve System shall be designed using motor-operated valves where required.

   Basis: *These requirements are per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Sections 3.1.2.1.8.a.*

3.1.4 Codes, Standards, and Regulations

Design requirements applicable to the Piping, Jumper, and Valve System come from government and non-government source documents and various codes and standards. Each document (of the exact revision identified) in this section is invoked by one or more requirements of this specification and represents a part of this specification to the extent specified.

3.1.4.1 Government Documents

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State constitute a part of this specification to the extent specified herein. The regulatory documents that form a part of this specification are listed in Table 3-1.

Table 3-1. Government Documents

Document Number	Title
DOE 5820.2A, 1988	*Radioactive Waste Management,* U.S. Department of Energy, Washington, D.C.
DOE 6430.1A, 1989	*General Design Criteria,* U.S. Department of Energy, Washington, D.C.
DOE/RL-96-109, Rev. 0	*Hanford Site Radiological Control Manual (HSRCM-1),* U.S. Department of Energy-Richland Operations Office, Richland, Washington.
RCRA, 1976	*Resource Conservation and Recovery Act of 1976, 42 USC 6901.*
WAC 173-303-640, 1999	"Dangerous Waste Regulations," *Washington Administrative Code,* as amended.

3.1.4.2 Non-Government Documents

National codes, standards, and the Hanford Site documents listed in Table 3-2 constitute a part of this specification to the extent specified herein. The RPP-PROs implement federal and state regulations and DOE Orders. In addition, it should be noted that some requirements are based on the existing authorization basis documents (e.g., HNF-SD-WM-FSAR-067, HNF-SD-WM-TSR-006, etc.). The Authorization Basis requirements may be changed, if necessary, after analysis and justification of the resulting risk being incurred have been outlined in a final safety analysis report (FSAR) amendment and approval is obtained from the DOE Office of River Protection (ORP). In addition, the list of procedures is not intended to be complete, but rather to identify key ones which, when implemented, will support successful completion of design activities. Specific other procedures/documents are referenced throughout the sections of this document.

Table 3-2. Non-Government Documents

Document Number	Title
ASME B16.34, 1998	*Valves-Flanged, Threaded, and Welding End,* American Society of Mechanical Engineers, New York, New York.
ASME B31.3, 1999	*Process Piping*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section V, 1998	*Non-Destructive Examination*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section IV	*Heating Boilers*, American Society of Mechanical Engineers, New York, New York.
API 598, 1996, 7th Edition	*Valve Inspection and Testing*, American Petroleum Institute, Washington, D.C.
ASME NQA-1, 1994	*Nuclear Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP-PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP-PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP-PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP-PRO-701, Rev. 0, 1999	*Safety Analysis Process – Existing Facility.*
RPP-PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP-PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP-PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*

Document Number	Title
RPP-PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP-PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP-PRO-709, Rev. 0, 1999	Preparation and Control Standard for Engineering Drawings.
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2937, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2962, 1998	*A List of Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC) Requirements*, Numatec Hanford Corporation for Fluor Daniel Northwest for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 1A, 1999	*RPP Administration,* "Tank Farm Operations Equipment Labeling," Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-MP-599, Rev. 3, 1999	*Project Hanford Quality Assurance Program Description*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TSR-006, Rev. 1, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-HSP-002, Rev. 3A, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-5183, Rev. 0, 1999	Tank Farms Radiological Control Manual, Fluor Daniel Hanford, Richland, Washington.

3.1.5 Operability

The controls for piping, jumper, and valve systems have been identified. These controls include designation of new Safety Class and Safety Significant pieces of equipment and the application of the existing Technical Safety Requirements (TSRs) and Administrative Controls (ACs). Analyzed accidents include various spray leaks from transfer jumpers as well as dilution/flush water jumpers and surface and sub-surface leaks resulting in a pool. Identified safety structures, systems, and components include:

- Isolation Valves;
- Dilution/flush water pressure switches and flow preventers; and,
- Instrumentation required to implement SLs, TSRs & ACs associated with transfer operations.

The Administrative Controls specified are as follows:

a. **Requirement:** Service Water pressure detection systems shall be operable. The service water pressure detection system may be inoperable for 30 minutes during pump priming or flushing activities. The local WASTE transfer pump shall not be started until the service water pressure detection system is OPERABLE.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, LCO 3.1.2 Service Water Pressure Detection Systems.

b. **Requirement:** A program shall be maintained to manage potential ignition sources that can initiate a fire or flammable gas deflagration.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 5.0, AC5.10, Ignition Controls. This requirement applies since in line sensors are installed in the ex-tank intrusive region of a WASTE tank (transfer-associated structure) by this project have electrical design specifications requiring all electrical equipment meet NFPA 70, Class 1, Division 1, Group B criteria.

c. **Requirement:** A program shall be maintained to control encasement seal loop drain line isolation valves (hydrostatic test valves).

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 5.0, AC 5.13 (Encasement Seal Loop Controls).

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

a. **Requirement:** The system components, including the inner and outer surfaces of the primary confinement piping and inner surfaces of the secondary piping, shall be designed to perform their intended function in the chemical environment defined in HNF-2937.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.5.2.1.

b. **Requirement:** The system shall be designed for the maximum bounding radiation environment for direct contact with waste as defined in HNF-2004.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.5.2.2.

c. **Requirement:** Transfer valves and manifolds shall be fabricated using materials compatible with the transfer of solutions over the range specified in RPP-5346, table 5-1. These waste properties reflect conditions at the transfer pump discharge.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.5.2.3.*

d. **Requirement:** All system components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, 1300-11.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.8.a.*

3.2.2 ALARA

a. **Requirement:** The Piping, Jumper, and Valve System shall be designed to keep personnel exposures As Low As Reasonable Achievable (ALARA) in accordance with RPP-PRO-1621 and RPP-PRO-1622.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.6.1.a.*

3.2.3 Nuclear Criticality Safety

N/A

3.2.4 Industrial Hazards

a. **Requirement:** The Piping, Jumper, and Valve System shall incorporate occupational safety and health design features that comply with the requirements of HNF-SD-WM-HSP-002.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.6.1.*

3.2.5 Operating Environment and Natural Phenomena

a. **Requirement:** The Piping, Jumper, and Valve System shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.5.1.a.*

b. **Requirement:** The system shall be designed to withstand the natural phenomena hazards as specified in RPP-PRO-097.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.5.1.b.*

c. **Requirement:** All equipment installed in areas in and around the tank that are subject to ignition controls shall be designed to meet the requirements of HNF-SD-WM-TSR-006, Section 5.10, "Ignition Controls." Areas requiring controls are delineated in HNF-SD-WM-SAR-067, Appendix K. The Flammable Gas Equipment Advisory Board shall be consulted whenever the application or interpretation of the requirements is unclear.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.6.3.*

3.2.6 Human Interface Requirements

a. **Requirement:** System design shall comply with DOE Order 6430.1A, Section 1300.12, "Human Factors Engineering."

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.7.a.*

3.2.7 Specific Commitments

No specific commitments have been identified.

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

a. **Requirement:** Tank dome loading shall satisfy the requirements specified in HNF-IP-1266, Chapter 5.16.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.6.2.b.*

3.3.2 Mechanical and Materials

a. **Requirement:** The seal loop jumper shall be designed to impede the flow of any dangerous waste or liquid in the secondary confinement drain pipe to ensure that the leak detector in the Transfer Piping System will detect the failure of the primary containment or the presence of any dangerous waste or accumulated liquid in the secondary containment within 24 hours. The amount of anticipated leakage to actuate the leak detector shall be calculated during design of the system. The Washington State Department of Ecology, through the final status permitting process, may approve or disapprove the final system design.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.1.16.a.*

b. **Requirement:** Valve manifolds and jumpers shall be 3-in. nominal diameter piping, except where limited by existing pit design.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.a, as modified by engineering judgment.*

c. **Requirement:** Valves or operators shall be provided with mechanical stops located as shown in Table 3-3 if a system similar to Project W-314 is used. The operators and stops shall prevent over torquing and plastic deformation of the valves.

Table 3-3. Valve and Operator Stop Locations

Valve or Operator	Stop Position 1 (in degrees)	Stop Position 2 (in degrees)
2-Way T-Handle Operated Valve	0	90
3-Way T-Handle Operated Valve	0	180
2-Way Motor Operated Valve	-3	93
3-Way Motor Operated Valve	-3	183
2-Way Manual Gear Operator	-3	93
3-Way Manual Gear Operator	-3	183

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.b.*

d. **Requirement:** Jumpers shall be provided with lifting bails positioned suitable for balanced lifting by crane.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.i.*

e. **Requirement:** Nozzle, manifold, and jumper assembly connections installed in new pump or valve pits should be of the Plutonium-Uranium Extraction (PUREX)-type designed in accordance with drawings H-2-32430 and H-2-32420 or H-2-821324 and H-2-821325.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.j.*

f. **Requirement:** Manifold and jumper assembly connections installed in existing pump and valve pits and diversion boxes shall be designed to mate to existing nozzles.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.k.*

g. **Requirement:** The valve position hardware, as applicable, shall be designed to facilitate quick mechanical/electrical disconnect for ease of cover block removal and replacement.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.m.*

h. **Requirement:** All valves shall prevent spray leaks resulting from over-torquing of valve stems.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.p.*

i. **Requirement:** The transfer jumper and nozzle components should be 304L stainless steel. All piping shall be ASTM A312 type 304L stainless steel.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.1.a.*

j. **Requirement:** All ball valves shall be full-ported, zero-cavity, and shall meet the applicable design and fabrication requirements contained in ASME B16.34.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.1.b.*

k. **Requirement:** Valve manifold piping and DST addition drop-legs shall meet the applicable design and fabrication requirements contained in ASME B31.3.

Basis: *This requirement is HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.1.c.*

l. **Requirement:** Jumpers shall meet the applicable design and fabrication requirements contained in HS-BS-0084.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.1.d.*

3.3.3 Chemical and Process

Any applicable chemical- or process-related requirements are covered in other sections.

3.3.4 Electrical Power

a. **Requirement:** All electrical connections shall be designed as applicable with quick-disconnects for ease of cover block removal and replacement.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.4.f.*

b. **Requirement:** Electrical equipment enclosures shall be as a minimum NEMA Type 4, per NEMA ICS 6.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.1.g. Note: the Design Authority is processing paperwork to resolve issue. Electrical enclosures and junction boxes of the proper NEMA rating shall be utilized.

c. **Requirement:** Electrical materials and equipment shall be UL or FM tested, with label attached, for the purpose intended, whenever such products are available. Where no UL or FM listed products of the type are available, testing, and certification by the RPP Design Authority in conjunction with the Flammable Gas Equipment Advisory Board or by a nationally recognized testing laboratory (NRTL) shall be acceptable.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 4.1.2.a.

3.3.5 Instrumentation and Control

a. **Requirement:** The system shall comply with electromagnetic radiation emission requirements set forth in HNF-2962.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.2.

b. **Requirement:** Capillary fluids used in sensing elements shall be compatible with tank waste.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.1.k.

3.3.6 Computer Hardware and Software

No computer hardware and software requirements are identified for the Piping, Jumper, and Valve System.

3.3.7 Fire Protection

No fire protection requirements are identified for the Piping, Jumper, and Valve System.

3.4 Testing And Maintenance Requirements

3.4.1 Testability

a. **Requirement:** All testing of equipment and instruments will have the ability to be performed without having to have personnel access pits (other than with video cameras for leak tests) or without having to remove any equipment from the pit. This is important from an ALARA standpoint and from a time to perform the task standpoint. Required tests must be able to be performed within their specified periodicity without impacting Waste Feed Delivery operations. This can only be accomplished by not having to remove the equipment and not having to perform a pit entry.

Basis: This requirement is per HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis, Volume 4, Waste Feed Delivery Operations and Maintenance Concepts, Section 3.5.

3.4.2 Technical Safety Requirement (TSR) Required Surveillance

a. **Requirement:** The service water pressure detection pressure detection systems shall be verified as operable.

Basis: This requirement is per HNF-SD-WM-TSR-006, LCO 3.1.2.

b. **Requirement:** A functional test on the service water pressure detection systems shall be performed to verify a setpoint of ≤20 lb/in^2 gauge on increasing pressure.

Basis: This requirement is per HNF-SD-WM-TSR-006, LCO 3.1.2.

3.4.3 Non-Technical Safety Requirement Inspections and Testing

a. **Requirement:** Seat closure tests shall be performed for all transfer valves in accordance with the test methods in ASME B16.34 and API 598. Seat leakage from each flow side to the isolated port shall be within the limits specified in API 598.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 4.1.2.b.

b. **Requirement:** Shell tests shall be performed for all transfer valves in accordance with ASME B16.34.

Basis: This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 4.1.2.c.

c. **Requirement:** All newly installed jumpers shall be leak tested prior to installation and use.

Basis: *This requirement is based on good engineering practice and per AC 5.12.*

d. **Requirement:** Three-way valves on the jumpers shall be leak tested in all possible orientations prior to installation. This testing is in addition to the hydrotest of the pressure boundary of the jumper assembly.

Basis: *This requirement is based on good engineering practice, ANSI/ASME B16.34.*

3.4.4 Maintenance

a. **Requirement:** The design of valve manifolds, jumpers, and process instrumentation installed in process pits shall include features to minimize contamination of other equipment within the pit, and the pit itself, during routine operation and removal or repair activities.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.4.a.*

b. **Requirement:** Jumpers and jumper components shall be repairable or replaceable within 24 hours. This timeframe does not include preparatory work such as preparing procedures, staging personnel and equipment, preparatory training, fabrication of jumper or component.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.4.g.*

c. **Requirement:** The low-point leak detector sensors shall be repairable or replaceable within 8 hours. Time to repair does not include preparatory work such as preparing procedures, staging personnel and equipment, or preparatory training.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.4.h.*

d. **Requirement:** Components internal to transfer associated structures shall be designed to be remotely removed, replaced, and operated.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.5.1.a.*

e. **Requirement:** Components external to transfer-associated structures shall be designed for minimal contact maintenance and hands-on operation.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.5.1.b.*

f. **Requirement:** All components requiring maintenance, calibration, or hands-on operation shall be located external to the pits. Transmitters for the liquid level, flow, temperature, and pressure shall be located external to the pits.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.5.1.f.

g. **Requirement:** Designs shall provide for the detection and isolation of electronic faults associated with valve position switches; and temperature, pressure, and flow elements.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.5.1.g.

3.5 Other Requirements

3.5.1 Security and Special Nuclear Material Protection

There are no security or SNM protection requirements identified for the Piping, Jumper, and Valve System.

3.5.2 Special Installation Requirements

a. **Requirement:** Except for the check valves, all jumper valves shall be ball valves designed for installation in the stem-up position.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.d.

b. **Requirement:** Two-way valves shall be designed to close in the clockwise direction.

__Basis:__ These requirements are per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.n.

c. **Requirement:** Taps for instrumentation and test connections shall be made on the top of the pipe.

__Basis:__ These requirements are per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.2.q.

d. **Requirement:** The valve position switches shall be located above the pit cover block.

__Basis:__ This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.4.e.

e. **Requirement:** Waste transfer paths connected to active waste transfer routes shall be provided with two isolation valves. (Note: Three-way valves are considered isolation valves in the context of this requirement.)

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.6.3.b.*

f. **Requirement:** Valve manifolds, jumpers, and DST addition drop-legs shall be provided with lifting attachment points for installation of the assembly into position. Lifting attachment points for valve manifolds, jumpers, and DST addition drop-legs shall be designed such that the assembly can be adjusted to hang plumb within 1 in. (±2.54 cm) over its length during installation with a crane. Below-the-hook lifting hardware, if required, shall be designed and provided with the assembly. Design shall be in accordance with ANSI/ASME B30.2 and DOE/RL-92-36.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.5.1.d.*

3.5.3 Reliability, Availability, and Preferred Failure Modes

a. **Requirement:** Removable components located beneath cover blocks including valves, in-line sensing devices, and jumpers shall have a design life of 12 years without maintenance. (TBR)

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.3.b.*

b. **Requirement:** Valves manufacturers shall provide written recommendations of operational practices such as preventative maintenance to maximize the valves useful life.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.3.c.*

c. **Requirement:** Valves shall be designed for at least 1000 cycles over their design life.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.3.d.*

d. **Requirement:** Valve closure should be sufficiently slow enough to prevent damage from water hammer.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.3.e.*

e. **Requirement:** Where practical, pipe elbow/bends shall have a bend radius greater than or equal to a long-radius elbow.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.2.3.f.*

3.5.4 Quality Assurance

a. **Requirement:** Quality assurance for the Piping, Jumper, and Valve System shall be performed in accordance with HNF-IP-0842, Volume XI, Section 1.0.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 4.0.*

b. **Requirement:** Design verification shall be performed on the Piping, Jumper, and Valve System subject to the procedure identified in RPP-PRO-1819, Section 2.9.1.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 4.2.*

3.5.5 Miscellaneous

a. **Requirement:** The system shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.3.a.*

b. **Requirement:** Valves shall be marked in accordance with ASME B16.34. In addition, the valve shall be provided with a stainless steel tag stamped with the following data:

- Valve working pressure,
- Maximum seat temperature rating,
- Trim material,
- Seat and seal material,
- Figure number,
- Year manufactured, and
- Manufacturers order number.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.3.b.*

c. **Requirement:** Valve T-handles shall be uniquely identified by valve and pit number.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.3.c.*

d. **Requirement:** Valve manifolds, jumpers, and cover blocks shall be marked to indicate the center of gravity and weight.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.3.d.*

e. **Requirement:** All like equipment and parts shall be interchangeable/standardized to the maximum extent practicable.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.3.5.*

f. **Requirement:** Records, documents, and drawing control pertinent to design functions shall be in accordance with RPP-PRO-222 and RPP-PRO-224. Drafting standards for drawings and interface control shall be in accordance with RPP-PRO-709.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.4.a.*

g. **Requirement:** All SSCs shall be incorporated into the master equipment list in accordance with HNF-IP-0842, Volume II, Section 6.1.

Basis: *This requirement is per HNF-4160, Piping, Jumper, and Valve System Specification, Rev. 0, Section 3.4.b.*

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

4.1.1 Description of System, Subsystems, and Major Components

The following sections provide a brief description of the major components of the Piping, Jumper, and Valve System. A simplified diagram of the system configuration is shown in Figure 4-1.

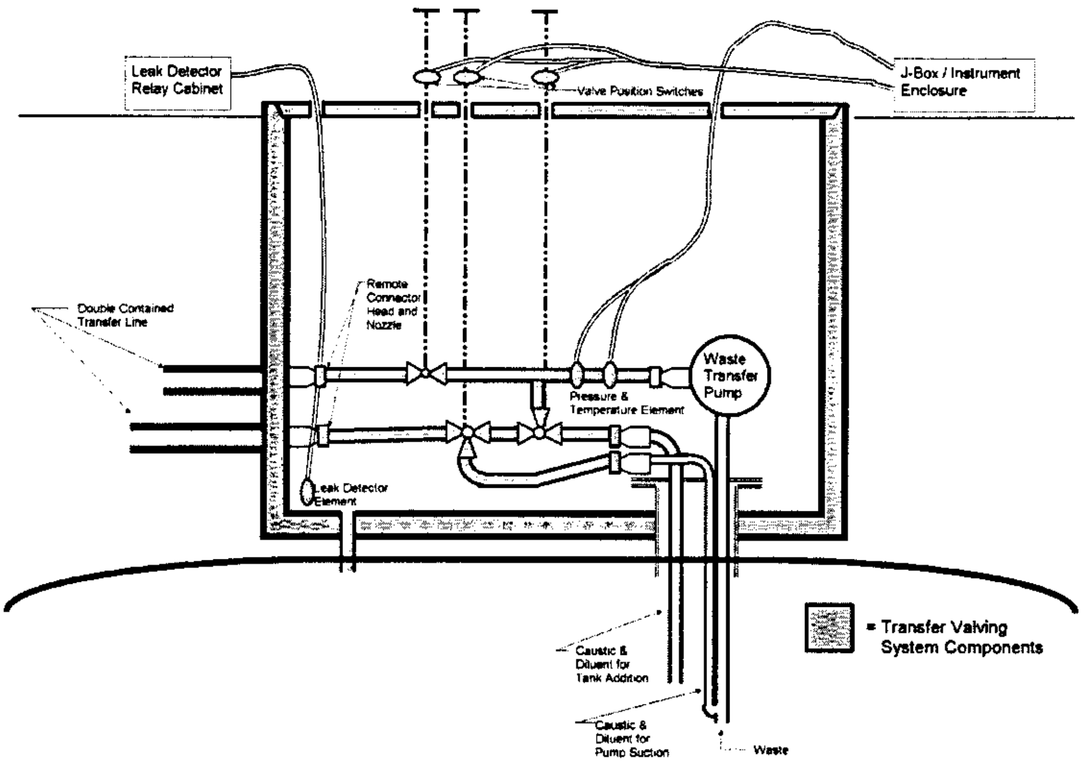

Figure 4-1. Piping, Valve, and Jumper System Configuration

4.1.1.1 Valve Manifolds/Jumpers

The valve manifolds/jumpers provide a confined routing path for the transfer of tank waste among storage locations and for routing caustic, diluent, and flush water. The manifolds allow waste, caustic/diluent, and flush water, to be routed from one nozzle location to another within a transfer-associated structure. In addition, drain jumpers allow waste to back-up enough to set off encasement leak detectors while still allowing the encasements to fully drain to a transfer-associated structure. The valve manifolds/jumpers will be made from rigid piping systems with male or female PUREX nozzle ends attached so that connections can be made remotely. The piping size will be 3 or 2-in depending on the size of the interfacing nozzle. All pipe material will be ASTM A312 type 304L stainless steel. The valves within valve manifolds are devices by which flow in the transfer system can be started, stopped, or regulated. Valves within transfer-associated structures will be manually or motor-operated depending on how often the valves are operated and what amount of breakaway torque will be required. Manual-operated valves may be operated by reach rods and "T-handles" or by gearboxes with handwheels external to the pits. Valve position sensors are local and remote indicators that identify the position of the valve. Remote position indicators will indicate where flow is being ported or whether the valve is open or closed. The local indication will show the valve's precise position based on mechanical devices connected to the valve stem. Motor operators and valve position indicators will be located above the pit cover blocks. Pit and encasement leak detection will be provided by the DST Monitoring and Retrieval Control System (ref. W-521-SDD-04).

4.1.1.2 In-Line Sensors

Temperature, pressure, density, and flow elements will be located on valve manifolds/jumpers in the transfer-associated structures and will provide output signals to transmitters. The transmitters and switches will be located outside of the pit for maintenance purposes.

4.1.1.3 DST Addition Drop-Legs

The DST Addition Drop-Legs route the waste or caustic/diluent into the tank through a riser. The drop-legs may also be provided with dispersion holes or ports to distribute the waste within the tank. Drop-legs that extend below the waste level are provided with openings above the waste to prevent drawing a vacuum when the transfer line is drained.

4.1.2 Boundaries and Interfaces

Subsystems that interface with the Piping, Jumper, and Valve System are the Transfer Pump System; the RPP/WTF Piping System; the Valve/Pump Pits and Cover Block System; the Electrical/Water Utilities System; the Diluent and Flush System; and the DST Monitoring and Retrieval Control System. The waste transferred through the valve manifolds/jumpers interfaces with the Transfer Pump System, New Piping System, and the Diluent and Flush System at a PUREX-type connector that is part of the valve manifold/jumper or anchored to the transfer-associated structure. The valve manifolds/jumpers interface with the cover blocks at sleeves through the cover blocks for valve handles or electrical cables. The leak detection sensors and in-line sensors interface with the Electrical Utilities System and the DST Monitoring and Retrieval Control System above grade at a plugged connections. Details of these interfaces are identified in the W-521 Interface Control Drawings.

4.1.3 Physical Location and Layout

The physical location of each piping, jumper, and valve system for Project W-521 is identified in Table 4-1.

Table 4-1. Piping, Jumper, and Valve System Locations

Valve/Pump Pit	System Components Included		
	Valve Manifold/ Jumper	In-Line Sensors	Drop-Leg
241-AP	X		
241-AP-A	X		
241-AW-01A	X	X	X
241-AW-02A	X	X	
241-AW-03A	X	X	X
241-AW-04A	X	X	X
241-AW-A	X	X(1)	
241-AW-B	X	X(1)	
241-AY-01A	X	X(1)	X
241-AY-02A	X	X(1)	X
241-SY-01A	X	X	X
241-SY-02A	X	X	X
241-SY-03A	X	X	X
241-SY-A	X	X(1)	
241-SY-B	X	X	

(1) Includes safety class pressure elements.

The piping used in the valve manifolds/jumper will be designed in accordance with the requirements of ASME B31.3. The piping material will be ASTM A312 Grade 304L stainless steel, Schedule 40. This selection is consistent with current RPP valve manifold/jumper projects (i.e., W-058, W-211, and W-314).

Valve manifolds/jumpers will be designed, if possible, so that they do not cross over other jumpers. If a crossover is required, the line most likely to need removal will always be on top. These would include jumpers to pumps or jumpers containing valves or instruments that have a higher probability of failure. The jumpers will be designed and balanced for remote handling by a single lifting bail. When suspended by their lifting bail, the jumpers will assume their installed position, and will be capable of remaining in place on the male nozzle when unsupported by the crane, while the connectors are being impacted. Additional supporting dunnage with supports that rest on the pit floor may be added to support the jumper while the connectors are being impacted. Dunnage will be used to provide protection/support during remote handling. The dunnage will be stainless steel. Four inch channel will be the preferred structural shape for dunnage.

4.1.4 Principles of Operation

The designed temperature range for the valve manifolds/jumpers will be 50-200°F, which is the expected temperature extremes for the system. The designed maximum pressure for the piping is 450 psig that is based on the pressure design limit of the PUREX Connectors. Jumpers will be designed to drain to in-pit equipment and will have no traps.

Valves will fail in the "as-is" position, allowing waste to drain to the source and destination tanks. The flush system is isolated from the waste transfer system by two valves with redundant pressure transmitters between them on the jumper connecting the two systems. During waste transfer operations the valves are closed to isolate the flush system from the transfer system. If waste leaks by the first valve, the pressure transmitter will actuate an alarm and shut down the transfer pump.

As indicated in Table 4-2, the piping, jumper, and valve system will be designed for a higher pressure than some of the existing intra-farm piping to which it is connected. Therefore, this piping will be protected from over pressurization by a relief in the transfer pump discharge jumper. A rupture disk will be located immediately upstream of and in line with the relief valve to keep the valve from becoming contaminated under normal conditions and thereby facilitate valve calibration and maintenance. At a pressure of 2 percent below the relief valve set pressure the rupture disk will rupture, an alarm will activate at the operator control station, and the relief valve will discharge into the tank from which the transfer is originating. The relief valve setting will also be based on the lowest maximum operating pressure of connected tank farm piping that can receive flow from the piping, jumper, and valve system.

Table 4-2. Connected Intra-Farm Piping Design Pressures

Valve/Pump Pit	Line Connected	Design Pressure
241-AW-01A	SN-261	275 psi
241-AW-02A	SN-267 & -268	
241-AW-03A	SN-263	
241-AW-04A	SN-264	
241-AY-01A	SN-635	400 psi
241-AY-02A	SN-633 & -635	
241-SY-01A	SN-278 (New)	450 psi
241-SY-02A	SN-277 (New)	
241-SY-03A	SN-279 (New)	

4.1.5 System Reliability Features

Although the valve manifolds/jumpers are designated as GS, Project W-521 will analyze the valve manifolds/jumpers to the SC design loads in RPP-PRO-097. The pressure switches on the service water tie-ins are designated as safety-significant items. These items will be designed, fabricated, installed, and inspected to SC requirements, however, since natural phenomena events were not a factor in the safety classification, these components will be analyzed to GS design loads.

4.1.6 System Control Features

System control features for the Piping, Jumper, and Valve System are described in the SDD for the DST Monitoring and Retrieval Control System.

4.1.6.1 System Monitoring

The pressure switches will be monitored continuously by the Master Pump Shutdown (MPS) System.

4.1.6.2 Control Capability and Locations

Control capability and locations will be defined as the design progresses.

4.1.6.3 Automatic and Manual Actions

Pumps will automatically shut down upon activation of the pressure switches.

4.1.6.4 Setpoints and Ranges

Setpoints and ranges will be defined as the design progresses.

4.1.6.5 Interlocks, Bypasses and Permissives

These controls will be defined as the design progresses.

4.2 Operations

The WFD Operations and Maintenance (O&M) Philosophy provides the project with constraints and guidance on system operations and developing operations procedures. The O&M Philosophy and the WFD O&M Concept (HNF-1939) are the primary bases for developing the Project Operations Plan. The O&M Concept is strongly influenced by the primary interfaces with the WTF. Significant penalties and/or increased costs may be incurred for failure to provide waste feed of sufficient quality and quantity. Therefore, new facilities and upgrades of existing facilities are being designed such that there is minimal disruption of WFD due to system failures. System design and operation is optimized to support availability, reliability, and accommodate parallel processes where appropriate. Most of the concepts in the O&M Philosophy are related to keeping the WFD systems operating while supplying feed to the WTF and minimizing the shutdown time necessary for maintenance and repairs.

Systems are designed to be as reliable as possible with little or no preventive maintenance or testing. The higher initial costs associated with more robust SSCs will be recovered through reduced down time, repairs, and avoiding contractual costs from the inability to provide feed to the WTF. The Operations Plan and Operations Procedures development are developed in coordination with interfacing projects to ensure a consistent O&M concept is implemented for all waste retrieval systems supporting WFD. The guidance for preparation and content of operations documentation is provided in HNF-IP-0842, Volume IV, Section 2.15 "Operations and Maintenance Planning Process" and on the RPP Systems Engineering Web Site.

Prior to each initial system startup, readiness to start-up will be verified to meet the intent and requirements of the PHMC procedure for facilities startup and readiness, RPP-PRO-55 "Facilities Start-Up Readiness" which implements U.S. Department of Energy (DOE) Order 425.1, *Startup and Restart, of Nuclear Facilities.* The level and type of review will be conducted at the lowest practical level commensurate with the project safety risk.

4.2.1 Initial Configuration (Pre-Startup)

Prior to each transfer of waste through the new valve manifolds/jumpers, valve orientations will be physically verified for proper alignment.

4.2.2 System Start-up

New piping, jumper, and valve systems will be started as part of the approved transfer procedures for that specific tank and will be performed by qualified operators.

4.2.3 Normal Operations

New valve manifolds/jumpers will be operated in accordance with the approved operating procedures for each specific transfer. The operators will not have their attentions distracted by outside influences such as music radios, televisions, books not related to transfer operations, etc. In order to ensure that the control area operators are not distracted, it is recommended that they have no other duties other than to operate their cognizant systems.

4.2.4 Off-Normal Operations

Off-normal operations will be covered in the applicable operating and emergency response procedures for the specific transfer the new valve manifold/jumper is installed for. Generally, the response to any off-normal situation will be to place the system in a safe, shutdown condition if operator response is not likely to mitigate the situation. The on-duty operators may perform this shutdown in a controlled manner manually from the control area, or it may occur automatically, depending on the speed necessary to place the system in a safe condition. Loss of normal power scenario: upon loss of normal power and failure of backup power, a system flush must occur to keep waste in the lines from cooling and allowing dissolved solids to precipitate out, clogging transfer lines with precipitate.

4.2.5 System Shutdown

The valve manifolds/jumper piping systems will be shutdown as part of their respective transfer system operating procedures.

4.2.6 Safety Management Programs and Administrative Controls

These controls will be defined as the design progresses.

4.3 Testing and Maintenance

4.3.1 Temporary Configurations

In order to perform some maintenance and testing activities, it may be necessary to align the system other than that for normal operations. Any situations requiring temporary configurations will be controlled via formal work procedures to ensure normal system configuration is restored when the maintenance or testing activity is complete. Under no circumstances will the system be allowed to operate with a temporary configuration until a formal temporary procedure change is written and approved. This procedure change process will ensure a USQ screening is performed and that the system will not be operated outside of its Authorization Basis.

4.3.2 TSR-Required Surveillance

The TSR Required Surveillance's related to maintenance and testing for the Piping, Jumper, and Valve System are as follows:

- SR 3.1.2.1 (verify that service water pressure detection systems are operable) – Once within 72 hours prior to removing an administrative lock from a physically connected waste transfer pump.
- SR 3.1.2.2 (perform functional test on the service water pressure detection systems and verify a setpoint of $\leq$ 20 lb/in^2 gauge on increasing pressure) – 365 days.

4.3.3 Non-TSR Inspections and Testing

Specific non-TSR inspections and testing for the Piping, Jumper, and Valve System have not been identified. However, appropriate preventive and predictive maintenance will be performed to maintain the equipment in a satisfactory condition throughout the design life.

4.3.4 Maintenance

Analysis will show acceptability over design life with no preventative maintenance. Maintenance on the piping, jumper, and valve system is expected to only be required for the process instrumentation and valving. The process instrumentation and valving at the valve/pump pits will be installed on removable piping jumpers. In addition, any regular maintained items are located outside the pit. The valve operators extend up through the cover blocks and therefore can be maintained without removal of any shielding. The valve manifold and jumper instrumentation requiring access under the cover blocks are the temperature RTDs and pressure transmitters. Spare RTDs have been installed so replacement of an RTD is not anticipated. Access to a pressure transmitter requires removal of a cover block(s).

4.3.4.1 Post Maintenance Testing

Specific post modification testing activities for the Piping, Jumper, and Valve System have not been identified. However, post maintenance testing will be conducted to ensure maintenance is properly performed, the identified/original deficiency is corrected, and the equipment is restored to an operational status. The rigor of post maintenance tests will be based on the extent of maintenance performed and the importance to plant/system safety and reliability. Post maintenance testing will be performed and documented in accordance with HNF-IP-0842, Volume V, Section 7.2 "Post Maintenance Testing" and HNF-IP-0842, Volume IV, Section 4.28 "Testing Practices Requirements."

4.3.4.2 Post-Modification Testing

Specific post modification testing activities for the Piping, Jumper, and Valve System have not been identified. However, post modification testing will be essentially the same as post maintenance testing. It is performed to ensure that the safety related functions of a system still perform satisfactorily after the system or equipment has been modified. Post modification testing is performed in accordance with the same guiding documents used for post maintenance testing.

RIVER PROTECTION PROJECT/WASTE TREATMENT FACILITY TRANSFER PIPING SYSTEM DESIGN DESCRIPTION

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Task 00008
Report No.W-521-SDD-06
Revision 2

September 2000

Prepared by: Tom Salzano, P.E.

Approved by: RL Fritz
Robert L. Fritz

Date: 9-29-00

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Tables

Acronyms

AC	Administrative Controls
ACD	Advanced Conceptual Design
ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
DOE	U.S. Department of Energy
DST	Double-Shell Tank
FSAR	Final Safety Analysis Report
GS	General Service
HLW	High Level Waste
HNF	Hanford Nuclear Facility
LAW	Low Activity Waste
PUREX	Plutonium-Uranium Extraction
RPP	River Protection Project
SC	Safety Class
SDD	System Design Description
SNM	Special Nuclear Material
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To be determined
TBR	to be refined
TSR	Technical Safety Requirements
TWRS	Tank Waste Remediation System
UL	Underwriters Laboratories
UPC	Uniform Plumbing Code
WAC	Washington Administration Code
WFD	Waste Feed Delivery
WFDS	Waste Feed Delivery System
WTF	Waste Treatment Facility

1.0 INTRODUCTION

This System Design Description (SDD) identifies performance requirements, defines their bases, and provides references to the requisite codes and standards for the River Protection Project (RPP)/Waste Treatment Facility (WTF) Transfer Piping System which is part of the Waste Feed Delivery System (WFDS) Project W-521. This Transfer Piping System revision incorporates Level 2 requirements as specified in HNF-4161, Rev. 0, *Double-Shell Tank Transfer Piping Subsystem Specification.* This SDD addresses all new waste transfer lines to be installed by W-521 (ref. Table 4-1).

1.1 System Identification

The RPP/WTF Transfer Piping System is double-walled underground piping that provides the primary and secondary confinement of the waste. Besides the primary and secondary confinement piping, the following major components are:

- Secondary confinement drain piping,
- Secondary confinement protection system, and
- Leak detection system. *

*This SDD addresses the piping characteristics required to support leak detection. The leak detection elements are addressed in the Retrieval Control SDD (ref. W-521-SDD-04).

1.2 Limitations

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary, or of a highly conceptual nature. This SDD will be a living document throughout the design phases of W-521, and will become more detailed as the design progresses through Definitive Design. Requirements were taken from the *Double-Shell Tank Transfer Piping Subsystem Specification,* HNF-4161, Rev. 0. The previous revision was based on the Draft Level 2 Specifications.

1.3 Ownership

The Project Engineer owns this SDD responsible for the RPP/WTF Transfer Piping System.

1.4 Definitions

General Service (GS) SSC – Structures, systems, or components (SSCs) not classified as either Safety Class or Safety Significant.

Manifold – Remotely installed rigid piping system inside a pit that transfers waste and flush water between nozzles.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

  - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
  - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
  - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
  - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
  - Two Safeties – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

  (**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

Pit Nozzle – Rigid male connector anchored in the pit wall or the transfer pump housing that provides a leak-tight connection with the integral seal block attached to a manifold.

RPP Design Authority – A person qualified in the practice of engineering with four years demonstrated job related experience including two years in their specific functional areas. For nuclear structures, systems, or components, they shall have at least one-year nuclear experience.

Safety Class (SC) SSC – An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant (SS) SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall – Denotes a requirement.

Tank Opening – Tank risers and pits with an open path to the tank.

TBD – To be determined. A study and/or calculation need to be performed in order to provide a sufficient technical basis for the requirement.

TBR – To be refined. A "soft" basis for the requirement has been identified. However, a further study and/or calculation need to be performed in order to solidify the requirement's technical basis.

Transfer-Associated Structure – Pump pits, valve pits, diversion boxes, or cleanout boxes.

Waste Feed – Waste slurry to be transferred to the WTF containing a mixture of solids and liquids.

2.0 GENERAL OVERVIEW

2.1 System Functions

The overall mission of the RPP/WTF Transfer Piping System is to reliably deliver the required quantities of tank waste feed to the WTF on schedule, within specifications, and in conformance with regulatory, safety, and contractual requirements. To accomplish this mission, the RPP/WTF Transfer Piping System must meet the requirements of the following functions:

- Confine Waste Within Transfer Piping,
- Confine Waste Leakage Within Secondary Containment Piping ,
- Confine Diluent/Flush Water Within DST Transfer Piping, and
- Detect Leaks to initiate appropriate actions.

The safety functions of the RPP/WTF Transfer Piping System are as follows:

- Contain waste during transfers,
- Prevent the release of waste to the soil from a primary confinement pipe leak,
- Ensure that a leak in the primary piping is directed to a waste transfer associated structure,
- Provide awareness of underground transfer piping to prevent an excavation accident from rupturing the transfer lines, and
- Prevent exposure of the onsite and offsite worker to a spray release.

2.2 System Classification

Table 2-1 identifies the preliminary safety classification of new RPP/WTF transfer piping system components as stated in HNF-SD-WM-SAR-067, ECN 650166, and Tank Waste Remediation System (TWRS) Final Safety Analysis Report (FSAR).

Table 2-1. Preliminary Safety Classification of RPP/WTF Transfer Piping System Components

Component	GS	SS
Transfer Primary Piping	X	
Transfer Encasement Piping		X
Encasement Leak Detection Drain Valve		X
Encasement Loop Seal Piping		X

GS = general service
SS = safety significant

2.3 Basic Operational Overview

The RPP/WTF Transfer Piping System will be used for LAW and HLW waste transfers to the RPP/WTF. A simplified diagram of the system is shown in Figure 2-1. The major functions of each major component are described below.

- The primary piping is used to confine waste as it moves between the defined end-points.
- In the unlikely event of a breach of the primary piping pressure boundary, the secondary confinement piping confines any leakage from the primary confinement piping and gravity drains waste to a transfer-associated structure. Leak detectors provide notification of waste leakage from the primary confinement piping into the secondary confinement piping.
- Secondary confinement drain piping will drain waste from the secondary confinement piping low points into a transfer-associated structure.
- The secondary confinement protection system will provide corrosion protection through a coating/ wrapping.

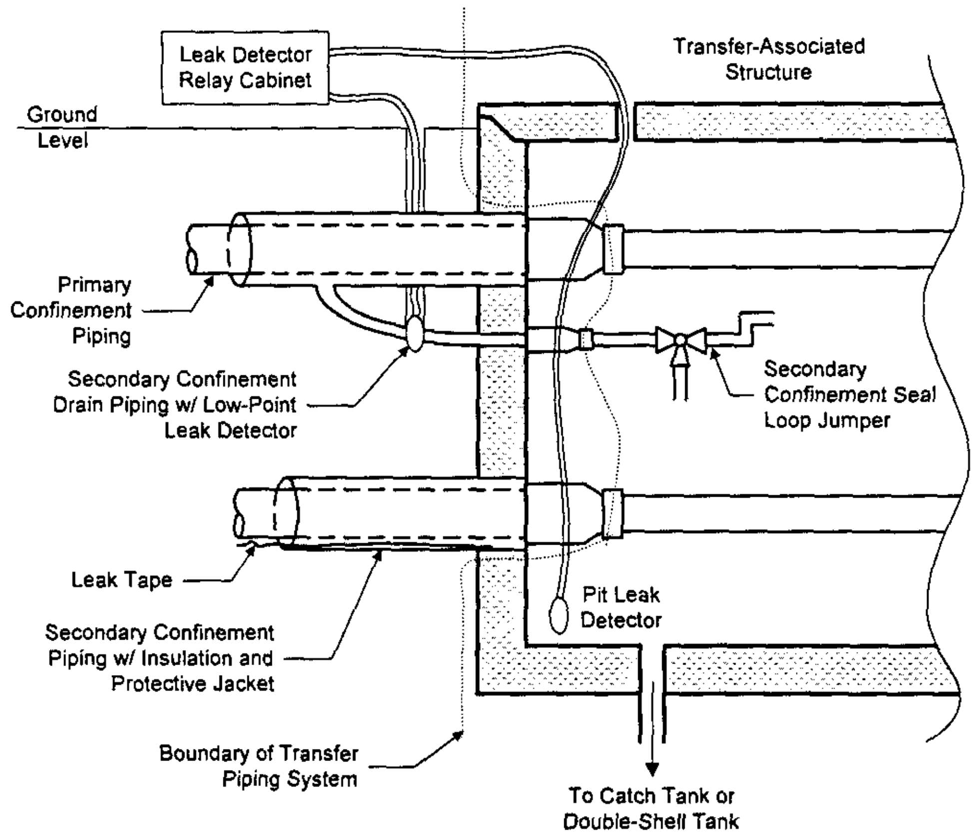


Figure 2-1. RPP/WTF Transfer Piping System Major Components

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section identifies the general requirements for the RPP/WTF Transfer Piping System and the bases for these requirements.

3.1.1 System Functional Requirements

a. **Requirement:** The RPP/WTF Transfer Piping System shall confine waste within the primary confinement piping.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.1.1.

b. **Requirement:** The RPP/WTF Transfer Piping System shall be capable of confining waste leaked from the primary piping.

Basis: *This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.1.2.*

c. **Requirement:** The RPP/WTF Transfer Piping System shall confine diluent/flush within the primary confinement piping.

Basis: *This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.1.4.*

3.1.2 Subsystems and Major Components

3.1.2.1 Primary Confinement Piping

a. **Requirement:** The primary confinement piping shall confine waste or diluent/flush water at a design pressure of 3103 kPa (450 lbf/in^2 gauge).

Basis: *This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, and Rev. 0, Sections 3.2.1.1.a. and 3.2.1.4.a, as modified per Design Authority direction.*

b. **Requirement:** Primary piping and encasements shall be fully drainable and shall be designed and fabricated to minimize crud traps.

Basis: *This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.8.b. and 3.3.8.c.*

c. **Requirement:** The primary piping shall support an interior corrosion/erosion allowance of 0.4 mils per year (0.01 mm per year) for the life of the system.

Basis: *This requirement is derived from Internal Memo 77120-91-030, A.P. Larrick to J.M. Light, "Recommendation on Material Selection for Replacement of the Cross-Site Transfer Line, Project W-058," dated April 22, 1991. The waste that will be transferred through the W-521 RPP/WTF Transfer Piping System is assumed to be no more corrosive or cause more erosion that the waste transferred through the cross-site transfer system.*

3.1.2.2 Secondary Confinement Piping (including Drain Piping)

a. **Requirement:** The secondary confinement piping should confine waste at the same design pressure as the primary confinement pipe

Basis: *This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, and Rev. 0, to meet the Confine Waste Leakage Within Secondary Confinement Piping, Section 3.2.1.2.a.*

b. **Requirement:** The secondary confinement piping shall extend through the concrete wall of transfer-associated structures to maintain secondary confinement.

Basis: This requirement is derived from 40CFR Part 265, Subpart J "Tank System."

3.1.3 Boundaries and Interfaces

Subsystems that interface with the RPP/WTF Transfer Piping System are the Piping, Jumper, and Valve System, the Electrical/Water Utilities System, the DST Monitoring and Retrieval Control System, the RPP /WTF and the Transfer-Associated Structures. These interface relationships are illustrated in Figure 3-1.

3.1.3.1 Retrieval Control Systems

a. **Requirement:** The leak detector sensor combined with the secondary confinement seal loop jumper (from the Transfer Valving Subsystem) shall be designed and operated such that it will detect the failure of the primary containment or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours. The amount of anticipated leakage to actuate the leak detector shall be calculated during design of the system. The Washington State Department of Ecology, through the final status of permitting process, may approve or disapprove the final system design.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.1.3.a.

b. **Requirement:** The low point leak detector sensors shall be repairable or replaceable within 8 hours. Tim to repair does not include preparatory work, such as preparing procedures, staging personnel and equipment, or conducting preparatory training.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.4.a.

c. **Requirement:** The continuous leak detectors shall be repairable or replaceable within <TBD hours. Time to repair does not include preparatory work, such as preparing procedures, staging personnel and equipment, or conducting preparatory training.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.4.b.

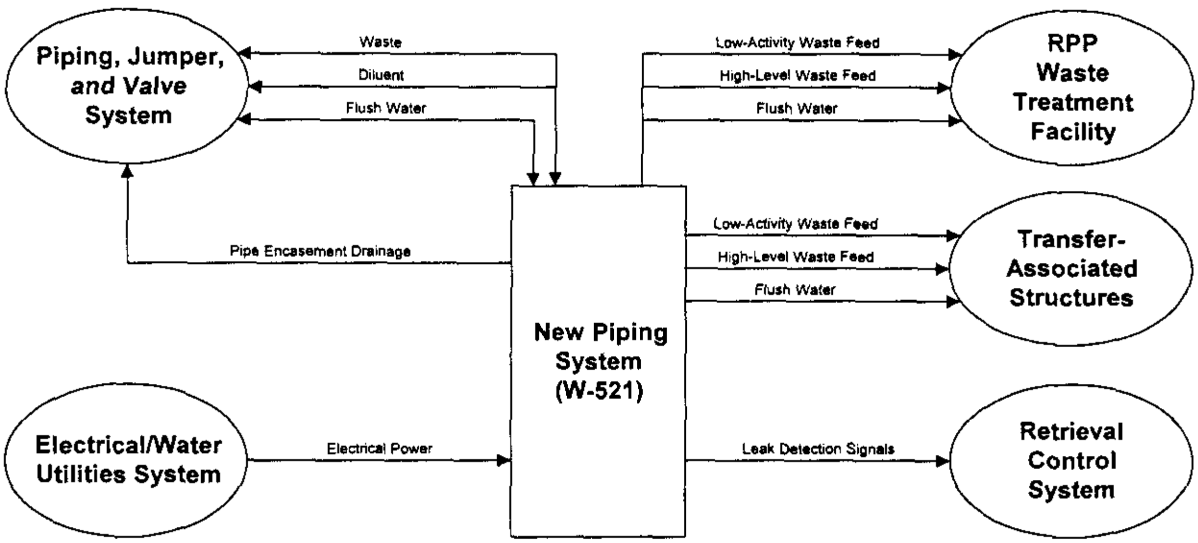


Figure 3-1. RPP/WTF Transfer Piping System Interfaces

3.1.3.2 Piping, Jumper, and Valve System

a. **Requirement**: The RPP/WTF Transfer Piping System shall be designed to receive and transfer the waste, flush, or diluent coming from the Piping, Jumpers, and Valve System at a pressure not to exceed the design pressure.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.1.2.1.1.a.

b. **Requirement**: The RPP/WTF Transfer Piping System shall be designed such that the leak detector sensor, combined with the secondary confinement seal loop jumper, will detect a leak.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.1.2.1.1.b.

3.1.3.3 RPP Waste Treatment Facility

a. **Requirement:** The RPP/WTF shall provide a rupture disk at the low-point of the LAW and HLW secondary confinement piping to allow a leak to be routed to a transfer-associated structure.

Basis: *This requirement is necessary to allow an inert gas atmosphere to be maintained in the secondary confinement space to protect the leak detection cable from condensation activation.*

b. **Requirement:** The RPP/WTF shall route four 3-in. primary confinement with 6-in. secondary confinement transfer lines from the coordinates defined in ICD No. 19 and 20 to a transfer-associated structure.

Basis: *WTF Interface control document 19420.*

3.1.4 Codes, Standards and Regulations

Design requirements applicable to the RPP/WTF Transfer Piping System come from government and non-government source documents and various codes and standards. Each document (of the exact revision identified) in this section is invoked by one or more requirements of this specification and represents a part of this specification to the extent specified.

3.1.4.1 Government Documents

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State constitute a part of this specification to the extent specified herein. The regulatory documents that form a part of this specification are listed in Table 3-1.

Table 3-1. Government Documents

Document Number	Title
DOE 5820.2A, 1988	*Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.
DOE 6430.1A, 1989	*General Design Criteria*, U.S. Department of Energy, Washington, D.C.
DOE/RL-96-109, Rev. 2, 1999	*Hanford Site Radiological Control Manual (HSRCM-1)*, U.S. Department of Energy-Richland Operations Office, Richland, Washington.
WAC 173-303-640,1999	"Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

3.1.4.2 Non-Government Documents

National codes, standards, and the Hanford Site documents listed in Table 3-2 constitute a part of this specification to the extent specified herein. Note: The RPP-PROs implement federal and state regulations and DOE orders. In addition, it should be noted that some requirements are based on the existing authorization basis documents (HNF-SD-WM-SAR-067, HNF-SD-WM-TSR-006, etc.). The Authorization Basis requirements may be changed, if necessary, after analysis and justification of the resulting risk being incurred have been outlined in a final safety analysis report (FSAR) amendment and approval is obtained from DOE Office of River Protection. In addition, the list of procedures is not intended to be complete, but rather to identify key ones which, when implemented, will support successful completion of design activities. Specific other procedures/documents are referenced throughout the sections of this document.

Table 3-2. Non-Government Documents

Document Number	*Title*
AASHTO, H20-44, 1996	*Standard Specification for HS-20, Highway Loading*, American Association of State Highway and Transportation Officials.
ASME B31.3, 1999	*Process Piping*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section V, 1998	*Non-Destructive Examination*, American Society of Mechanical Engineers, New York, New York.
ASME NQA-1, 1994	*Nuclear Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
ASTM-A312, 2000	*Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes,* American Society for Testing and Materials, West Conshohocken, Pennsylvania.
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP-PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP-PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP-PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP-PRO-701, Rev. 0, 1999	*Safety Analysis Process – Existing Facility.*
RPP-PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP-PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP-PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*
RPP-PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP-PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP-PRO-1819, Rev. 0, 1999	*PHMC Engineering Requirements.*
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization,* COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2937, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 1A, 1999	*RPP Administration,* "Tank Farm Operations Equipment Labeling, " Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.

Document Number	Title
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TRD-007, Rev. E Draft, 1998	*System Specification for the DST System*, COGEMA Engineering for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TSR-006, Rev. 0-R, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-HSP-002, Rev. 3A, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-5183, Rev. 0, 1999	Tank Farms Radiological Control Manual, Fluor Daniel Hanford, Richland, Washington.

3.1.5 Operability

No specific operational attributes have been identified for the RPP/WTF Transfer Piping System.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

a. **Requirement:** The subsystem components shall be designed to perform their intended function in the chemical environment defined in HNF-2937.

Basis: These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.5.2.1.

b. **Requirement:** The subsystem shall be designed for the 1,000 rad/h radiation environment for direct contact with tank waste as designed in HNF-2004.

Basis: These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.5.2.2.

c. **Requirement:** The subsystem components shall be fabricated using materials compatible with the pumping of solutions over the range specified in Waste Feed Delivery Transfer System Analysis, RPP-5346, Table 5-1.

Basis: These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.5.2.3.

d. **Requirement:** All system components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Section, and 1300-11.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.8.a.

3.2.2 ALARA

a. **Requirement:** Routing and shielding of the transfer piping shall be designed to keep personnel exposures as low as reasonably achievable (ALARA) in accordance with RPP-PRO-1621 and RPP-PRO-1622.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.6.1.a.

3.2.3 Nuclear Criticality Safety

N/A

3.2.4 Industrial Hazards

a. **Requirement:** The system shall incorporate design features that comply with the requirements of HNF-SD-WM-HSP-002 and other applicable safety and health requirements.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.6.1.b.

3.2.5 Operating Environment and Natural Phenomena

a. **Requirement:** The system shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501.

Basis: These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.5.1.a.

b. **Requirement:** The system shall be designed to withstand the natural phenomena hazards as specified in RPP-PRO-097.

Basis: These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.5.1.b.

c. **Requirement:** All equipment installed in areas in and around the tank that are subject to ignition controls shall be designed to meet the requirements of HNF-SD-WM-TSR-006, Section 5.10, "Ignition Controls." Areas requiring controls are delineated in HNF-SD-WM-SAR-067, Appendix K. The Flammable Gas Equipment Advisory Board shall be consulted whenever the application or interpretation of the requirements is unclear.

Basis: These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.6.3.b.

3.2.6 Human Interface Requirements

There are no human-system interface requirements specific to the RPP/WTF Transfer Piping System.

3.2.7 Specific Commitments

There are no specific commitments not identified elsewhere.

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

a. **Requirement:** The system shall be designed to withstand soil loads imposed by an AASHTO H20-44 wheel loading and a 100,000-lb crane loading in the tank farm area.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.6.2.c.

b. **Requirement:** Tank dome loading shall satisfy the requirements specified in HNF-IP-1266, Chapter 5.16.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.6.2.d.

3.3.2 Mechanical and Materials

a. **Requirement:** Primary confinement piping should be 3-in (80-mm) inside diameter

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.2.a.

b. **Requirement:** Transfer piping shall slope continuously from the high point(s) to a transfer-associated structure(s) with a minimum slope of 0.25%.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.2.b.

c. **Requirement:** The heat transfer properties of the as-installed piping subsystem shall be such that the waste heat loss is less than 25.6 Joules (26.2 BTU/h per foot) of pipe at the maximum waste temperature and flow rate.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.2.c.

d. **Requirement:** The primary confinement and secondary confinement piping and leak detector riser pressure boundary, shall be designed, fabricated, and installed in accordance with ASME B31.3.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.1.a.

e. **Requirement:** The primary confinement pipe shall be ASTM A312, Type 304L, stainless steel.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.1.b.

3.3.3 Chemical and Process

Any applicable chemical and process-related requirements are covered in other sections.

3.3.4 Electrical Power

a. **Requirement**: Electrical materials and equipment shall be Underwriter's Laboratories, Inc. (UL) listed, or factory mutual tested, with label attached, and for the purpose intended, whenever such products are available. Where no UL or factory mutual listed products are available, testing and certification by another nationally recognized testing agency may be acceptable, as long as the design agent documents the acceptance of the testing agency.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.1.2.a.

3.3.5 Instrumentation and Control

No instrumentation and control requirements are identified for the RPP/WTF Transfer Piping System.

3.3.6 Computer Hardware and Software

No computer hardware and software requirements are identified for the RPP/WTF Transfer Piping System.

3.3.7 Fire Protection

No fire protection requirements are identified for the RPP/WTF Transfer Piping System.

3.4 Testing and Maintenance Requirements

3.4.1 Testability

Testing features shall be designed to implement testing requirements. System design shall incorporate features for verifying system operability.

a. **Requirement**: All testing of equipment and instruments will have the ability to be performed without having to have personnel access pits (other than with video cameras for leak tests) or without having to remove any equipment from the pit. This is important from an ALARA standpoint and from a time to perform the task standpoint. Required tests must be able to be performed within their specified periodicity without impacting Waste Feed Delivery operations. This can only be accomplished by not having to remove the equipment and not having to perform a pit entry.

   Basis: *This requirement is per HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis, Volume 4, Waste Feed Delivery Operations and Maintenance Concepts, Section 3.5.*

b. **Requirement**: The subsystem shall provide the connections to periodically test the integrity of the primary and secondary confinement piping.

   Basis: *These connections are required to perform the hydrostatic testing of the system. This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.5.3.*

3.4.2 TSR-Required Surveillance

No TSR-Required Surveillances have been identified for the RPP/WTF Transfer Piping System.

3.4.3 Non-TSR Inspections and Testing

a. **Requirement**: The encasement pipe will be examined in accordance with Paragraph 341 of ASME B31.3 for normal fluid service. The requirement for 5% random radiography will be increased to 20%. In-process examination in accordance with Paragraph 344.7 may be substituted for the radiographic examination. If in-process examination is used, the root pass shall be examined by either the liquid penetrant or magnetic particle method.

   Basis: *These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.1.2.b.*

b. **Requirement:** In addition to the requirements of ASME B31.3, all secondary confinement piping welds will be examined by either the Liquid Penetrant Test or the Magnetic Particle Test. Longitudinal welds are the exception, which are the exception, which are required to be Ultrasonic Test examined. The Liquid Pentrant Test, Magnetic Particle Test, and Ultrasonic Test examinations will be performed in accordance wit the requirements of ASME Section V. The acceptance criteria for these examinations will be in accordance with the requirements of ASME Section III, ND-5300.

__Basis:__ These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.1.2.c.

c. **Requirement**: Material coupons, traceable to the heat number(s) of the pipe, will be tested to verify that the chemical and physical properties comply with the applicable ASTM Standards for the pipe. Certified Material Test Reports for the pipe will be submitted as a quality record.

__Basis:__ These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.1.2.d.

d. **Requirement:** Secondary confinement piping shall be leak tested hydrostatically or pneumatically. Hydrostatic tests shall be performed at 150% of design pressure in accordance with the test methodology in ASME B31.3. Pneumatic tests shall be performed to 120% of design pressure in accordance with the test methodology in ASME B31.3.

__Basis:__ These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.1.2.e.

e. **Requirement**: In addition to the requirements of ASME B31.3, all primary pipe welds shall be examined by 100% radiography.

__Basis:__ These requirements are per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.1.2.f.

3.4.4 Maintenance

a. **Requirement**: The subsystem shall incorporate corrosion prevention and control features in accordance with WAC 173-303-640(3) for final status facilities and 40 CFR 265, Subpart J for interim status facilities; DOE Order 6430.1A, Section 0262; and DOE Order 5820.2A, Chapter 1, Section 3.b(2)(g). The design of the subsystem shall allow for detection of a leak within 24 hours.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.6.2.a

b. **Requirement:** Below-grade portions of the system either shall not require preventive or corrective maintenance over the design life or shall be designed for preventive or corrective maintenance without requiring excavation.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.5.1.a.

3.5 Other Requirements

3.5.1 Security and Special Nuclear Material (SNM) Protection

No security or Special Nuclear Material (SNM) issues are associated with this system.

3.5.2 Special Installation Requirements

a. **Requirement:** Three-inch wide detectable plastic sheet marker tape shall be placed continuously above the transfer pipes in the backfill or berm soils. Route markers shall be provided at minimum of every 150 feet along the pipe line and at every change in direction to post the location of the underground transfer lines that are outside the Tank Farm fencing. A system of monuments and bench marks shall be provided along the pipeline routes.

Basis: TWRS Technical Safety Requirements, HNF-SD-WM-TSR-006, Rev. 0-L, AC 5.12, Transfer Controls and AC 5.17, Excavation Controls. These physical characteristics are required to reduce the likelihood of excavation damage to the transfer lines.

3.5.3 Reliability, Availability, and Preferred Failure Modes

a. **Requirement:** The RPP/WTF Transfer Piping System shall have a design life of 35 years.

Basis: This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.3.a.

b. **Requirement:** Pipe bends in the primary confinement piping should have a minimum bend radius of five pipe diameters.

Basis: This requirement is per the Radiological Design Guide, WHC-SD-GN-DGS-30011, Section 3.4.2, and the HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.2.3.b.

3.5.4 Quality Assurance

a. **Requirement:** Quality assurance for the RPP/WTF Transfer Piping System shall be performed in accordance with IP-0842, Volume XI, and Section 1.0.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.0.

b. **__Requirement:__** Design verification shall be performed on the RPP/WTF Transfer Piping System per the procedure identified in RPP-PRO-1819, Section 2.9.1.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 4.2.

3.5.5 Miscellaneous

a. **Requirement:** The system shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.3.3.a.

b. **Requirement:** Records, documents, and drawing control pertinent to design functions shall be in accordance with RPP-PRO-222, RPP-PRO-224. Drafting standards for drawings and interface control shall be in accordance with RPP-PRO-70.

__Basis:__ This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.4.a.

c. **Requirement:** All Transfer Piping Subsystem structures, systems, and components (SSC) shall be incorporated into the master equipment list in accordance with HNF-IP-0842, Vol. II, Section 6.1.

Basis: *This requirement is per HNF-4161, Double-Shell Tank Transfer Piping Subsystem Specification, Rev. 0, and Section 3.4.b.*

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

4.1.1 Description of System, Subsystems and Major Components

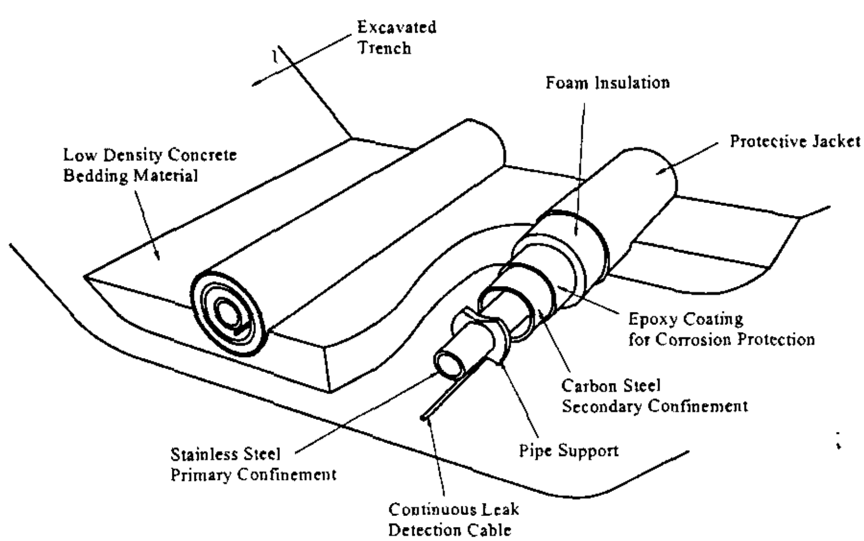
The new transfer piping will be buried and consist of a pipe-in-pipe configuration. The following provides a brief description of the major components of the RPP/WTF Transfer Piping System. A simplified diagram of the system configuration is shown in Figure 4-1.

Figure 4-1. RPP/WTF Transfer Piping System Configuration

4.1.1.1 Primary Confinement Piping

The primary piping is used to confine waste as it moves between transfer-associated structures or from a transfer-associated structure to the RPP/WTF interface points. The primary piping is designed to be self-draining and is capable of moving waste in either direction.

The primary confinement piping is 3-in., 304L stainless steel, Schedule 40. The only exception to this



will be in the replacement of 2"SL-161 in the 241-AW Tank Farm and replacement of 2" SL-180 in the 241-SY Tank Farm. These lines will be replaced with 2", ASTM A312 304L stainless steel, Schedule 40 primary confinement piping.

4.1.1.2 Secondary Confinement Piping

The secondary confinement piping confines any leakage from the primary confinement piping and gravity drains waste to a transfer-associated structure. The secondary piping provides the guides, deadweight supports, and anchors necessary to support the primary confinement piping. In addition, the secondary confinement piping shall provide standpipes, as required, for the installation and maintenance of the leak detectors and for integrity testing of the primary and secondary confinement piping.

The secondary confinement piping is 6-in., ASTM A106 Grade B carbon steel, standard weight with epoxy coating to minimize external corrosion. The only exception to this will be in the replacement of 2"SL-161 in the 241-AW Tank Farm and replacement of 2" SL-180 in the 241-SY Tank Farm. These lines will be replaced with 2" primary confinement piping with 4", ASTM A106 Grade B carbon steel secondary confinement piping with epoxy coating. The transfer lines to the WTF will also include expansion loops for each line where the secondary confinement piping will increase to 12-in. ASTM A106 Grade B carbon steel, standard weight pipe.

The safety functions of the secondary confinement piping are to prevent the release of waste to the soil and ensure that a leak is directed to a waste transfer-associated structure. An unobstructed void maintained between the primary and secondary confinement piping, and a sloped annular drain path to a transfer-associated structure on the low end where the leak can be detected will preserve the safety functions of the secondary confinement piping.

4.1.1.3 Secondary Confinement Drain Piping

Drain piping will drain waste from the secondary confinement piping low points into a transfer-associated structure. The transfer-associated structure shall provide the capability to accumulate a sufficient amount of leaked waste in the drain piping to ensure leak detection.

Leak detectors shall be provided to detect waste leakage from the primary confinement piping into the secondary confinement piping. The leak detectors consist of low point detectors for all piping in the WFDS except the feed lines to the RFP/WTF that will utilize continuous leak detection cable. New piping in the SY Farm and replacement of 2" SL-161 in the AW Tank Farm will not have encasement leak detectors, but will rely on the pit leak detector (ref. W-521-SDD-04, DST Monitoring and Retrieval Control System).

4.1.1.4 Secondary Confinement Protection System

The secondary confinement piping is epoxy coated, foam insulated and jacketed for corrosion protection and heat retention. The secondary confinement piping is covered with 2-in. of rigid polyurethane insulation. The insulation jacket is directly applied on the foam insulation.

4.1.2 Boundaries and Interfaces

Subsystems that interface with the RPP/WTF Transfer Piping System are the Piping, Jumper, and Valve System, the Electrical/Water Utilities System, the Retrieval Control System, and the RPP/WTF. The waste transferred through the piping interfaces with the Piping, Jumper, and Valve System at a PUREX-type connector anchored to the transfer-associated structure. The leak detection sensors in the secondary confinement piping interface with the Electrical Utilities System and the Retrieval Control System above grade at a plugged connections. The interface at the RPP/WTF is as specified in ICD No. 19 and 20.

4.1.3 Physical Location and Layout

The physical location of each new transfer piping system is identified in Table 4-1.

Table 4-1. New Transfer Piping System Locations

Line	Location		Leak Detection Type
	From	To	
#1 (SN-640)	New 241-AP-A Valve Pit	241-AP Valve Pit	Low-Point
#2 (SN-641)	New 241-AP-A Valve Pit	241-AP Valve Pit	Low-Point
#3 (LAW-702)	New 241-AP-A Valve Pit	Privatization Contractor LAW Interface	Cable
#4 (LAW-703)	New 241-AP-A Valve Pit	Privatization Contractor LAW Interface	Cable
#5 (HLW-700)	New 241-AP-A Valve Pit	Privatization Contractor HLW Interface	Cable
#6 (HLW-701)	New 241-AP-A Valve Pit	Privatization Contractor HLW Interface	Cable
#7 (DR-601)	New 241-AP-A Valve Pit	Riser (TBD) on 241-AP-101(TBD)	Low-Point
#8 (Replaced SL-161)	241-AW-A Valve Pit	241-AW-01A Pump Pit	Pit (1)
#9 (Replaced SN-278)	241-SY-B Valve Pit	241-SY-01A Pump Pit	Pit (1)
#10 (Replaced SN-279)	241-SY-B Valve Pit	241-SY-03A Pump Pit	Pit (1)
#11 (Replaced SN-280)	241-SY-B Valve Pit	241-SY-A Valve Pit	Pit (1)
#12 (Replaced SN-277)	241-SY-A Valve Pit	241-SY-02A Pump Pit	Pit (1)
#13 (Replaced SL-180)	241-SY-B Valve Pit	241-SY-A Valve Pit	Pit (1)

(1) The secondary encasement will be open to the pit and utilize the pit leak detection.

The piping is designed in accordance with the requirements of ASME B31.3. The material selection is consistent with current RPP transfer line projects (i.e.,W-058, W-211, and W-314). The new transfer piping systems will be designed with a minimum slope of 1/8 inch per foot as required for gravity drain lines per the Uniform Plumbing Code (UPC). If this is not feasible due to existing obstructions, then the lines will incorporate a continuous slope of greater than 0.25 percent.

The design of the buried pipe for new transfer piping will incorporate expansion loops and concrete anchors. A typical expansion loop design will be used to maximize the length between expansion loops thus minimizing the number of expansion loops used. The encasement pipe at the loops is 12 inch standard weight pipe that reduces down to the 6 inch schedule 40 pipe for the straight runs of pipe. The larger pipe at the expansion loops will accommodate the expansion of the primary confinement pipe. Anchors will be place between each expansion loop to force the thermal expansion of the primary pipe into the expansion loop. Anchors will also be placed at the corners, or change in direction of the pipeline to withstand the thrust forces developed by the secondary pipe, both thermally and seismically. An anchor will be place outside of the transfer-associated structures to reduce the anchor forces at the wall of the structures.

The buried transfer lines will be permanently marked with location markers. The warning indicators will be closely spaced and easily seen. The markings will be legible and identify, by line number, pipe(s) below grade.

4.1.4 Principles of Operation

The designed temperature range for the RPP/WTF Transfer Piping System will be 50-200°F, which is the expected temperature extreme for the system. The designed maximum pressure for the pipeline is 450 psig that is based on the anticipated pressure required for transfer. The maximum allowable pressure of the secondary confinement piping will also be 450 psig. Although the encasements with leak detection cable will be designed to support this maximum allowable pressure, the code design pressure for these encasements will be set at 50 psig to minimize the required pneumatic test pressure.

4.1.5 System Reliability Features

Project W-521 will design the transfer piping to safety-class criteria. Consistent with Projects W-058, W-211, and W-314, the design will follow the recommendations of the "Bush" assessment. The "Bush" assessment recommended the use of ASME B31.3 with the following enhancements:

- To insure quality of piping materials, certified material test reports will be required from the manufacturer. In addition, test coupons will be taken from each heat of material and will be analyzed for physical and chemical properties by an independent testing laboratory. Material certifications for weld filler materials will also be required.

- 100% volumetric examination (radiography) will be required on all piping welds.

These enhancements will be applied to the primary confinement piping. The secondary confinement piping will be analyzed to safety-class seismic criteria, however, 20% random radiographic examination will be applied. All secondary confinements will extend through the transfer-associated structure wall.

The insulation jacket for the buried pipeline will be designed to withstand a standard HS-20 truck loading as defined in AASHTO HB-15.

4.1.6 System Control Features

System control features for the RPP/WTF Transfer Piping System are described in the SDD for the DST Monitoring and Retrieval Control System.

4.1.6.1 System Monitoring

The leak detection sensors will be monitored continuously as defined in the DST Monitoring and Retrieval Control System.

4.1.6.2 Control Capability and Locations

Control capability and locations will be defined as the design progresses.

4.1.6.3 Automatic and Manual Actions

Pumps will automatically shut down upon activation of the leak detection sensors. This shut down function is installed by Project W-314.

4.1.6.4 Setpoints and Ranges

Setpoints and ranges will be defined as the design progresses.

4.1.6.5 Interlocks, Bypasses and Permissives

These controls will be defined as the design progresses.

4.2 Operations

The WFD Operations and Maintenance (O&M) Philosophy provides the project with constraints and guidance on system operations and developing operations procedures. The O&M Philosophy and the WFD O&M Concept (HNF-1939) are the primary bases for developing the Project Operations Plan. The O&M Concept is strongly influenced by the primary interfaces with the WTF. Significant penalties and/or increased costs may be incurred for failure to provide wasted feed of sufficient quality and quantity. Therefore, new facilities and upgrades of existing facilities are being designed such that there is minimal disruption of WFD due to system failures. System design and operation is optimized to support availability, reliability, and accommodate parallel processes where appropriate. Most of the concepts in the O&M Philosophy are related to keeping the WFD systems operating while supplying feed to the WTF and minimizing the shutdown time necessary for maintenance and repairs.

Systems are designed to be as reliable as possible with little or no preventive maintenance or testing. The higher initial costs associated with more robust SSCs will be recovered through reduced down time, repairs, and avoiding contractual costs from the inability to provide feed to the WTF. The Operations Plan and Operations Procedures development are developed in coordination with interfacing projects to ensure a consistent O&M concept is implemented for all waste retrieval systems supporting WFD. The guidance for preparation and content of operations documentation is provided in HNF-IP-0842, Volume IV, Section 2.15 "Operations and Maintenance Planning Process" and on the RPP Systems Engineering Web Site.

Prior to each initial system startup, readiness to start-up will be verified to meet the intent and requirements of the PHMC procedure for facilities startup and readiness, RPP-PRO-55 "Facilities Start-Up Readiness" which implements U.S. Department of Energy (DOE) Order 425.1, *Startup and Restart, of Nuclear Facilities*. The level and type of review will be conducted at the lowest practical level commensurate with the project safety risk.

4.2.1 Initial Configuration (Pre-Startup)

In the transfer piping to the WTF, a continuous cable is run in the annular region between the primary and secondary confinement pipe. Before initial startup, this annular region is filled with an inert gas to minimize corrosion and prevent spurious leak detection alarms due to condensation. After the annular region is filled, valves on each end of each encasement section are then closed to isolate the purge gas. Rupture disks will be provided in the encasement pipe to ensure that a leak will be directed to a transfer-associated structure.

4.2.2 System Startup

New transfer piping systems will be started as part of the approved transfer procedures for that specific tank and will be performed by qualified operators.

4.2.3 Normal Operations

New transfer piping systems will be operated in accordance with the approved operating procedures for each specific transfer. The operators will not have their attentions distracted by outside influences such as music radios, televisions, books not related to transfer operations, etc. In order to ensure that the control area operators are not distracted, it is recommended that they have no other duties other than to operate their cognizant systems.

4.2.4 Off-Normal Operations

Off-normal operations will be covered in the applicable operating and emergency response procedures for the specific transfer the new piping is installed for. Generally, the response to any off-normal situation will be to place the system in a safe, shutdown condition if initial operator response does not mitigate the situation. The on-duty operators may perform this shutdown in a controlled manner manually from the control area, or it may occur automatically, depending on the speed necessary to place the system in a safe condition. Piping systems by themselves don't normally have individual abnormal or emergency response procedures.

4.2.5 System Shutdown

The RPP/WTF Transfer Piping Systems will be shutdown as part of their respective transfer system operating procedures.

4.2.6 Safety Management Programs and Administrative Controls

These controls will be defined as the design progresses.

4.3 Testing and Maintenance

4.3.1 Temporary Configurations

In order to perform some maintenance and testing activities, it may be necessary to align the system other than that for normal operations. Any situations requiring temporary configurations will be controlled via formal work procedures to ensure normal system configuration is restored when the maintenance or testing activity is complete. Under no circumstances will the system be allowed to operate with a temporary configuration until a formal temporary procedure change is written and approved. This procedure change process will ensure a USQ screening is performed and that the system will not be operated outside of its Authorization Basis.

4.3.2 TSR-Required Surveillance

Specific TSR-Required Surveillances for the RPP/WTF Transfer Piping System have not been identified.

4.3.3 Non-TSR Inspections and Testing

Specific non-TSR inspections and testing for the RPP/WTF Transfer Piping System have not been identified. However, appropriate preventive and predictive maintenance will be performed to maintain the equipment in a satisfactory condition throughout the design life.

4.3.4 Maintenance

Analysis will show acceptability over design life with no preventative maintenance. Maintenance on the piping system is expected to only be required for the leak detection sensors. For systems with low-point leak detection sensors, the sensors can be removed at grade through flanged riser ports. The leak detection cable is capable of identifying the location of breaks and shorts on thè cable. Though infrequent, when either of these faults occur, pull ports will be provided approximately every 300 feet to permit the removal of nonfunctioning cable.

4.3.4.1 Post Maintenance Testing

Specific post maintenance testing activities for the RPP/WTF Transfer Piping System have not been identified. However, post maintenance testing will be conducted to ensure maintenance is properly performed, the identified/original deficiency is corrected, and the equipment is restored to an operational status. The rigor of post maintenance tests will be based on the extent of maintenance performed and the importance to plant/system safety and reliability. Post maintenance testing will be performed and documented in accordance with HNF-IP-0842, Volume V, Section 7.2 "Post Maintenance Testing" and HNF-IP-0842, Volume IV, Section 4.28 "Testing Practices Requirements".

4.3.4.2 Post-Modification Testing

Specific post modification testing activities for the RPP/WTF Transfer Piping System have not been identified. However, post modification testing will be essentially the same as post maintenance testing. It is performed to ensure that the safety related functions of a system still perform satisfactorily after the system or equipment has been modified. Post modification testing is performed in accordance with the same guiding documents used for post maintenance testing.

TRANSFER PUMP SYSTEM DESIGN DESCRIPTION

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Task 00008
Report No. W-521-SDD-07
Revision 2

September 2000

Prepared by: Stephen D. Riesenweber

Approved by: Robert L. Fritz

Date: 9-30-00

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Figures

Tables

Acronyms

AC	Administrative Controls
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWF	American Waste Facility
AWS	American Welding Society
DOE	U.S. Department of Energy
DST	Double-Shell Tank
ECN	Engineering Change Notice
FSAR	Final Safety Analysis Report
HLW	High Level Waste
HNF	Hanford Nuclear Facility
ICS	Industrial Controls and Systems
LAW	Low Activity Waste
LCO	Limited Conditions for Operation
NEMA	National Electrical Manufacturers Association
PUREX	Plutonium-Uranium Extraction
RPP	River Protection Project
RCSTS	Replacement Cross-Site Transfer System
SC	Safety Class
SDD	System Design Description
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To be determined
TBR	to be refined
TSR	Technical Safety Requirements
TWRS	Tank Waste Remediation System
WAC	Washington Administration Code
WFD	Waste Feed Delivery
WFDS	Waste Feed Delivery System
WTF	Waste Treatment Facility

1.0 INTRODUCTION

This System Design Description (SDD) identifies performance requirements, defines their bases, and provides references to the requisite codes and standards for the Waste Feed Delivery System (WFDS) Project, W-521 Transfer Pump System. The Advanced Conceptual Design (ACD) revision incorporated Level 2 requirements as specified in HNF-4162, Rev. 0, *Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0.*

1.1 System Identification

The transfer pumps and ancillary components described in this SDD provide the motive force to move waste from source tanks to staging tanks and from staging tanks to the Waste Treatment Facility (WTF) via new and existing transfer lines.

Transfer pumps are provided for the nine tanks included within the scope of Project W-521. Tanks included are: 241-AW-101, 241-AW-103, 241-AW-104, 241-AY-101, 241-AY-102, 241-SY-101, 241-SY-102, and 241-SY-103.

The Transfer Pump System is a subsystem of the WFDS Project. It is comprised of five major subsystems/components. These are:

- Motor,
- Pump,
- Pump Monitoring & Control,
- Pump Suction Level Adjustment, and
- Diluent Addition.

1.2 Limitations

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary, or of a highly conceptual nature. This SDD will be a living document throughout all design phases of Project W-521, and will become more detailed as the design progresses through Definitive Design. Requirements were taken from the *Double-Shell Tank Transfer Pump Subsystem Specification*, HNF-1462, Rev. 0. The previous revision was based on the Draft Level 2 Specifications.

1.3 Ownership

This SDD is owned by the Project Engineer responsible for Transfer Pump System.

1.4 Definitions

Active-An active component is one that is part of the "as-built" tank farms and has not been isolated and disconnected from all other tank farm components as part of an approved Engineering Change Notice (ECN).

Administrative Lock-A locking device that prevents an inadvertent equipment start. Administrative locks ensure that the equipment or systems(s) being isolated and/or controlled cannot be operated (e.g., removing the motive force of a transfer pump [e.g., electrical power, steam, water, or air] and installing an administrative lock so that the transfer pump cannot be activated) until the administrative lock is removed.

General Service (GS) SSC – Structures, systems, or components (SSCs) not classified as either Safety Class or Safety Significant.

Manifold-Remotely installed rigid piping system inside a pit that transfers waste and flush water between nozzles.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

  - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
  - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
  - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
  - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
  - Two Safety – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

  (**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

Safety Class (SC) SSC - An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant (SS) SSC - An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall - Denotes a requirement.

Should - Denotes a recommendation. If a "should" requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

Tank Opening - Tank risers and pits with an open path to the tank.

TBD - To be determined. A study and/or calculation needs to be performed in order to provide a sufficient technical basis for the requirement.

TBR - To be refined. A "soft" basis for the requirement has been identified. However, a further study and/or calculation needs to be performed in order to solidify the requirement's technical basis.

Waste Feed - Waste slurry to be transferred to the WTF containing a mixture of solids and liquids.

2.0 GENERAL OVERVIEW

2.1 System Functions

The overall mission of the Transfer Pumping System is to reliably deliver the required quantities of tank waste feed to transfer piping systems which transmit the waste to the treatment and immobilization facilities on schedule, within specifications, and in conformance with regulatory, safety, and contractual requirements.

Source tanks typically have three waste layers. The bottom layer, referred to as the non-convective layer, contains compacted salts/settled solids. The second layer is a liquid supernatant layer with a high concentration of sodium salts. The third layer (not present in all tanks) is called a crust, made up of partially dried solids floating on top of the supernatant layer.

Depending upon the processing needs at the various tanks, two types of transfers will be required. In LAW tanks, transfer pumps must be capable of pumping from a variable suction level that will allow pumping of supernatant liquids with only a minimal amount of entrained solids. In HLW tanks, the tank contents will be mixed with mixer pumps and the blended tank contents transferred. Some tanks require both types of transfer capabilities. Also, in some cases, it will be necessary to transfer waste while mixer pumps are operating in order to keep solids sufficiently entrained. In Section 4.0 below, Table 4-1 shows the transfer pump requirements for each tank.

The HNF-4162, *Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0,* identifies a "suite" of functions that apply to transfer pumps under the "Convey Waste" third tier functions. These include:

- Position Transfer Pump Suction,
- Pump Waste/Diluent,
- Confine Waste in Transfer Pump,
- Monitor Transfer Pump Operation, and
- Monitor Position of Transfer Pump Suction Intake.

2.2 System Classifications

Transfer pumps are classified as general service. They will, however, meet the flammable gas control requirements. Further, until supplemental direction is provided by the project, it is assumed that safety significant impact limiters will be required during installation of the pump. This approach is consistent with Project W-211 as documented in the preliminary safety documentation.

2.3 Basic Operational Overview

LAW and HLW transfers take two primary forms with each requiring somewhat different pumping arrangements. LAW supernatant transfers involve the transport of liquid wastes from the supernatant level with the minimum amount of solids possible. If mixing of the tank contents has taken place, insoluble solids are allowed to settle out prior to transfer. For this type of transfer, a pump is installed with an adjustable suction level device. This device is configured to allow the waste to be pumped from a point above the sludge/liquid interface. Figure 2-1 is a conceptual representation of one possible configuration of an adjustable suction pump.

HLW transfers involve mobilization (mixing) of the tank contents with mixer pumps prior to transfer. The intent is to provide a homogeneous mixture of the tank contents to the WTF. For this type of transfer the adjustable suction level is not needed; a single full-length pump will suffice. Figure 2-2 provides a representation of an installed full-length pump.

Prior to transfers, waste will be sampled, characterized, and recirculated. If needed, chemically treated and pre-heated water (referred to as diluent) can be added to the waste at the pump suction or to the tank liquid surface to make it conform to the WTF acceptance criteria or meet the bounding waste characteristics for transfers.

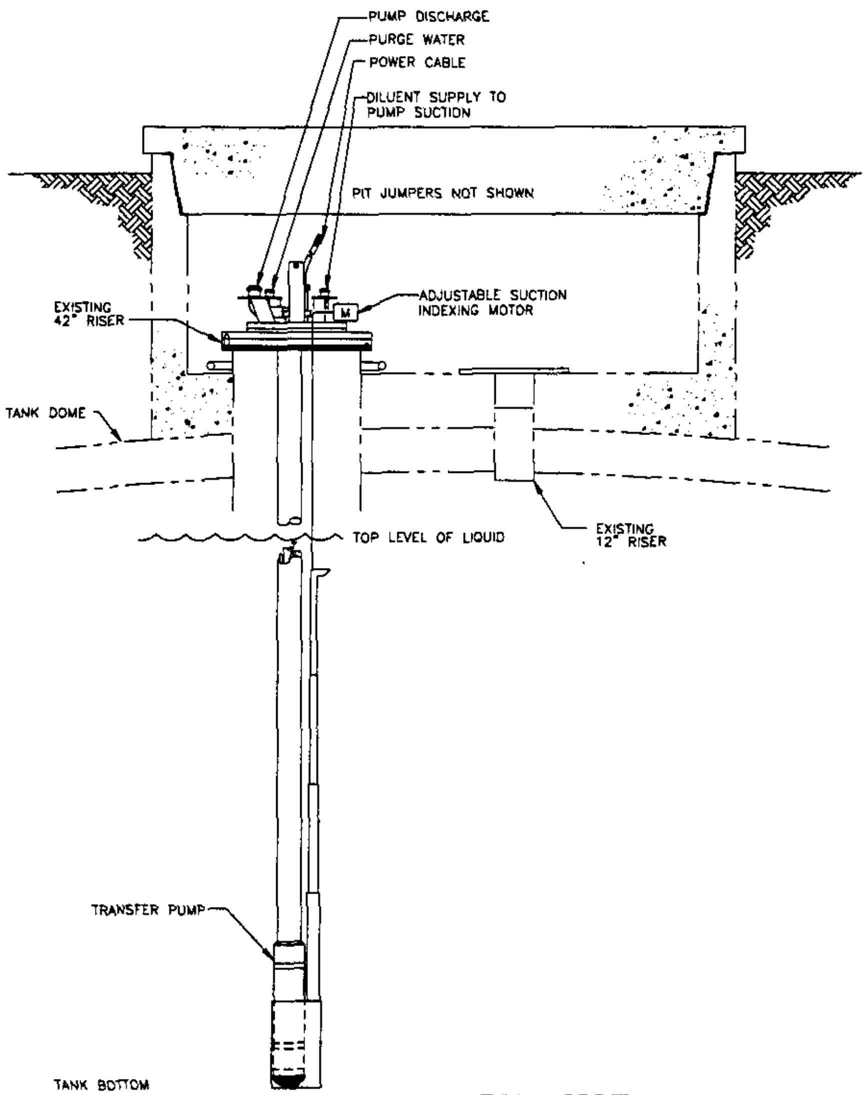

Figure 2-1. Adjustable Suction Pump System Configuration

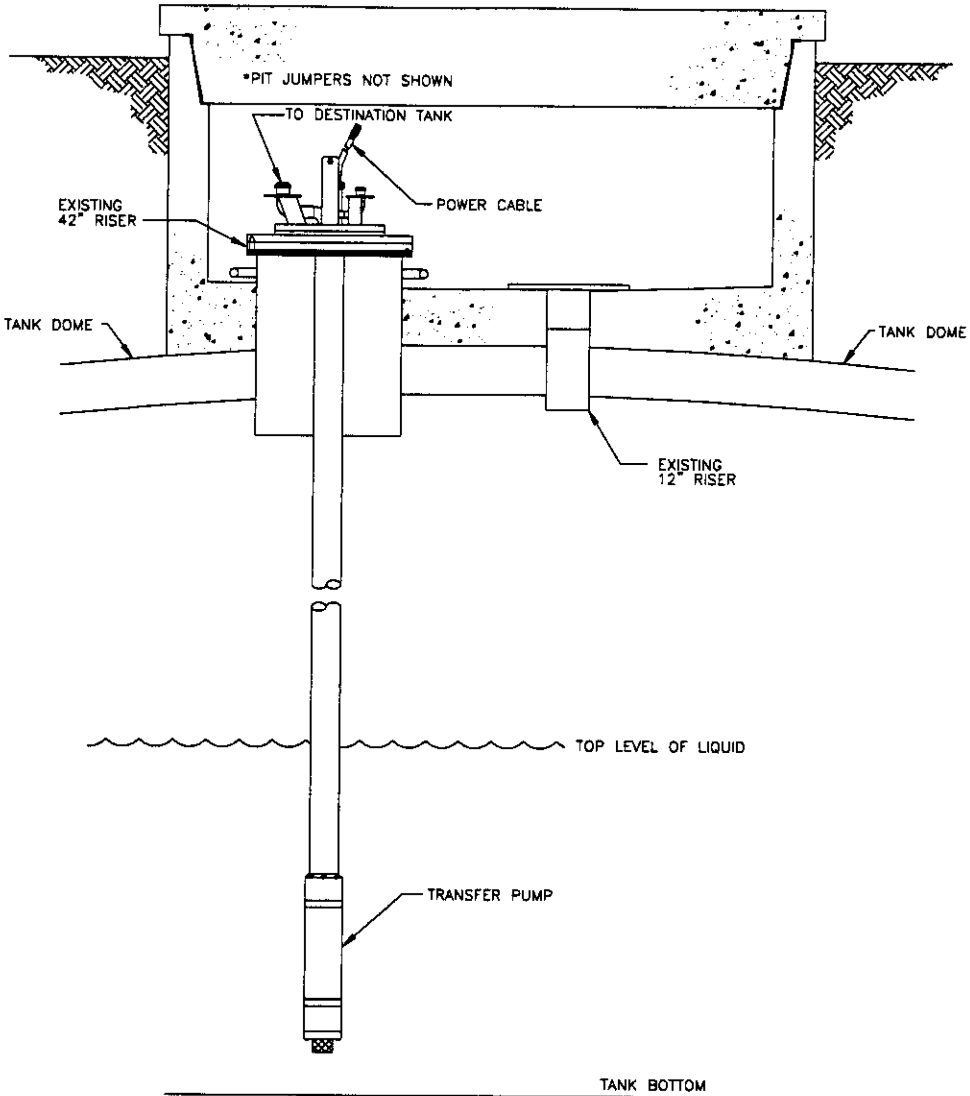

Figure 2-2. Full-length Transfer Pump System Configuration

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section identifies the general requirements for the Transfer Pump System and the bases for these requirements.

3.1.1 System Functional Requirements

This section contains all requirements related to physical characteristics (maximum/minimum physical size, weight, shape, etc.).

a. **Requirement:** The Transfer Pump System shall be capable of removing supernatant, dissolved salts, and suspended solids from source tanks and transferring them to destination tanks in accordance with the following parameters:

1. The transfer pump design operating point shall be 140 gal/min at 725 ft head (530 L/min at 217 meters) <TBR>

2. The transfer pump shall have a continuously rising head/capacity curve from the design point to the shut off head.

3. The shut off pressure of the transfer pump should not exceed 450 lb/in^2 gauge (3.1 Mpa) for waste specific gravity 1.4. <TBR>

4. The transfer pump should be able to remove waste to within 10 in. of tank bottom.

5. The transfer pump hydraulic performance design shall be based on the assumed following newtonian fluid properties <TBR> after in-line dilution and mixing at transfer pump suction.

• Specific Gravity	1.4
• Viscosity	30 centipoise <TBR>
• Solids Content	30 percent by volume
• Temperature	195 °F

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Sections 3.1.2.1.3.b, 3.2.1.1.a, 3.2.1.1.c, and 3.2.1.1.e.*

b. **Requirement:** Transfer pumps required to pump supernatant or dissolved salts (decant operations) shall be capable of taking suction in accordance with the following criteria.

- The system shall be capable of adjusting the pump suction from 10-in. to 20 ft.
- The system shall be capable of starting to within 46-in. of tank bottom.
- The system shall be capable of positioning the suction intake for all transfer pumps within 4-in. (10.2 cm) <TBR> of the desired position.

Basis: *This requirement is HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Sections 3.1.2.1.2, 3.2.1.2.a, and 3.2.1.2.b.*

c. **Requirement:** The transfer pump shall be designed to pump fluids with the range of properties defined in RPP-5346, Table 5-1.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.5.*

d. **Requirement:** The primary confinement shall be sized to maintain waste velocities greater than 6.0 ft/s (1.8 m/s) <TBR> at a flow rate ≥ 140 gal/min (530 L/min)

Basis: *This transfer velocity provides sufficient energy to keep all expected solids suspended during waste transfer (ref. HNF-2938, Appendix F.1.4).*

e. **Requirement:** The transfer pump shall be capable of delivering 10.1 L/s (160 gal/min) <TBR> (2.16 m/s [7.1 ft/s] <TBR> in 80 mm [3 in.] schedule 40 pipe) at heads ranging from 195 m (640 ft) <TBR> down to 15 m (50 ft), as measured at the pump discharge above the mounting flange.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.1.b.*

f. **Requirement:** The transfer pump shall deliver rated head and flow at a minimum net positive suction head available (NPSH.) of 4.6 m (15 ft.) <TBR>.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.1.f.*

g. **Requirement:** The shutoff head of the transfer pump shall not exceed 268 m (880 ft.) <TBR> as measured at the pump discharge above the mounting flange.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.1.d.*

3.1.2 Subsystems and Major Components

The Transfer Pump System includes four Primary components as defined in HNF-4162 including: Motor, Pump, Pump Monitoring & Control, and Pump Suction Level Adjustment. A fifth component, Diluent Addition/Flush, is added to provide provisions for functional requirements that do not fit into the other four.

a. **Requirement:** The Transfer Pump System shall accept and route diluent to the pump suction intake.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.5.

3.1.3 Boundaries and Interfaces

The Transfer Pump System has interfaces with six other systems. Figure 3-1 provides a representation of the primary interfaces for the Transfer Pump System.

a. **Requirement:** The raw water system shall have the capacity to provide water to flush the transfer pump seal or internal components, if required by design.

Basis: This requirement is based on engineering judgment related to known possible pump requirements.

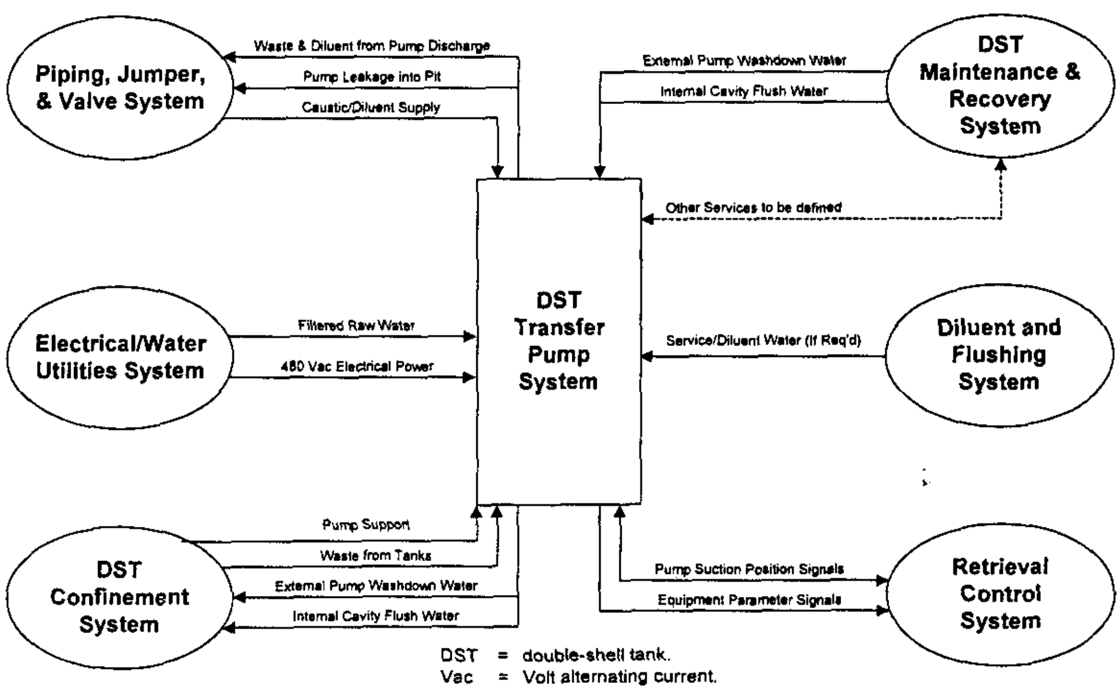

Figure 3-1. Primary Interfaces for the Transfer Pump System

b. **Requirement**: The Transfer Pump System shall be provided with an adapter flange capable of mating to a bag-out assembly for retracting the transfer pump into a "flexible receiver" during pump removal operations.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.2.g.*

c. **Requirement:** A "flexible receiver" and associated high-pressure water wash system shall be provided for decontamination and containment of the transfer pump as it is retracted from the tank in preparation for final waste packaging. All hardware needed to remove and replace a failed pump is part of this system.

Basis: *This requirement is based on the Project W-521 equipment retrieval and disposal approach.*

3.1.4 Codes, Standards and Regulations

3.1.4.1 Government Documents

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State constitute a part of the requirements for this SDD. These regulatory documents are listed in Table 3-1.

Table 3-1. Government Documents

Document Number	Title
DOE 5820.2A, 1988	*Radioactive Waste Management,* U.S. Department of Energy, Washington, D.C.
DOE 6430.1A, 1989	*General Design Criteria,* U.S. Department of Energy, Washington, D.C.
DOE/RL-96-109, Rev. 0	*Hanford Site Radiological Control Manual (HSRCM-1),* U.S. Department of Energy-Richland Operations Office, Richland, Washington.
RCRA, 1976	*Resource Conservation and Recovery Act of 1976, 42 USC 6901.*
10 CFR 835	Occupational Radiation Protection, Code of Federal Regulation, dated 11/98, Washington, D.C.

3.1.4.2 Non-Government Documents

National codes, standards, and the documents that form a basis for the Transfer Pump System requirements are listed in Table 3-2. Note: The RPP-PROs implement federal and state regulations and DOE orders. In addition, it should be noted that some requirements are based on the existing authorization basis documents (HNF-SD-WM-SAR-067, HNF-SD-WM-TSR-006, etc.). The Authorization Basis requirements may be changed, if necessary, after analysis and justification of the resulting risk being incurred have been outlined in a final safety analysis report (FSAR) amendment and approval is obtained from DOE Office of River Protection. In addition, the list of procedures is not intended to be complete, but rather to identify key ones which, when implemented, will support successful completion of design activities. Other specific procedures/documents are referenced throughout the sections of this document.

Table 3-2. Non-Government Documents

Document Number	Title
AASHTO, H20-44, 1996	*Standard Specification for HS-20, Highway Loading*, American Association of State Highway and Transportation Officials.
ASME B31.3, 1999	*Process Piping*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section V, 1998	*Non-Destructive Examination*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section IV	*Heating Boilers*, American Society of Mechanical Engineers, New York, New York.
ANSI Z358.1-1990	*Emergency Eyewash and Shower Equipment*, American National Standards Institute.
ASME NQA-1, 1994	*Nuclear Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
RPP-5982, Rev 0, 2000	*Elimination of Retrieval Risks Caused by Structural Variations and Debris in Tanks,* CH2M Hill Hanford Group, Inc., Richland, WA
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP-PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP-PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP-PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP-PRO-701, Rev. 0, 1999	*Safety Analysis Process – Existing Facility.*
RPP-PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP-PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP-PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*
RPP-PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP-PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP-PRO-1819, Rev. 0, 1999	*PHMC Engineering Requirements.*
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2937, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2962, 1998	*A List of Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC) Requirements*, Numatec Hanford Corporation for Fluor Daniel Northwest for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 1A, 1999	*RPP Administration Tank Farm Operations Equipment Labeling and Master Equipment List Control*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-MP-599, Rev. 3, 1999	*Project Hanford Quality Assurance Program Description*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation,

Document Number	Title
	Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TRD-007, Rev. E Draft, 1998	*System Specification for the DST System*, COGEMA Engineering for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TSR-006, Rev. 0-R, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
NACE RP 0169-96, 1996	*Control of External Corrosion Engineers*, Houston, Texas.
HNF-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-HSP-002, Rev. 3A, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-5183, Rev. 0, 1999	Tank Farms Radiological Control Manual, Fluor Daniel Hanford, Richland, Washington.

a. **Requirement:** The system shall comply with the general design guidelines provided in DOE Order 6430.1A, Sections 1300, 1323, and 1550-99.0.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 2.1.*

3.1.5 Operability

The controls for the Transfer Pump Systems have been identified (LMHC 1999a, 1999b, & 1999c). These controls include designation of new safety class pieces of equipment, several safety significant pieces of equipment, and the application of the existing Technical Safety Requirements (TSRs), and Administrative Controls (ACs) to the transfer activities. Analyzed accidents include various flammable gas deflagration scenarios and spray leaks from dilution/flush water systems. Identified safety structures, systems, and components include:

- Tank level monitoring systems,
- Dilution/flush water pressure switches and flow preventers, and
- Instrumentation required to implement TSRs & ACs associated with transfer pump operations.

While not all of these requirements are directly applicable to this system, this system interfaces with systems where these are directly applicable. The Limited Conditions for Operation (LCOs), Technical Safety Requirements (TSRs), and Administrative (ACs) specified are as follows:

a. **Requirement:** Service Water Pressure Detection Systems shall be operable

Basis: *This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, LCO 3.1.2. Service Water Pressure Detection System. This requirement applies since the retrieval/transfer pumps will have dilution/flush capabilities and could possibly be subjected to pump discharge pressure.*

b. **Requirement:** Transfer leak detection systems shall be OPERABLE.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, LCO 3.1.3. This requirement applies since there will be physically connected transfer pumps not under administrative lock.

c. **Requirement:** An active primary tank ventilation system shall be operable during operation of transfer pumps.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, LCO 3.2.1. This LCO is applicable since all waste DISTURBING ACTIVITIES and operations are required to be stopped immediately if active primary ventilation system becomes inoperable.

d. **Requirement:** One of the two primary tank leak detection systems listed below shall be operable during pump operation.

1. The annulus conductivity probe system, or buoyancy type instrument.
2. The annulus continuous air monitor (CAM) system.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, LCO 3.2.6. This requirement applies since retrieval/transfer pumps will have to be shut off if primary tank leak detection becomes inoperable.

e. **Requirement**: The WASTE temperature shall be either:

1. 195°F in all levels of the WASTE, or
2. $\leq$ 195°F in the top 15 ft. of the waste, and $\leq$ 215°F in the waste below 15 ft.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, LCO 3.3.2.

f. **Requirement:** A program shall be maintained for administrative lock controls on waste transfer pumps to minimize the potential for inadvertent pump starts.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 5.0, AC 5.20. This requirement applies since there are several program elements related to transfer pumps and physically connected transfer lines.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

a. **Requirement:** All equipment including sensing devices required to be installed in and around a tank that are subject to ignition controls, shall be designed in accordance with HNF-SD-WM-TSR-006, Section 5.10.

Basis: This requirement is per HNF-416, Double-Shell Tank Transfer Pump Subsystem Specification, Rev 0, Section 3.3.6.3.b.

b. **Requirement**: The system shall be designed for the maximum bounding radiation environment for direct contact with waste as defined in HNF-2004.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0. Section 3.2.5.2.2.

c. **Requirement**: The system design shall provide means of internally flushing the pump bowl or volute to reduce internal contamination levels before and during pump removal from the tank.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.8.d.

d. **Requirement**: Designs should simplify cut-up, dismantlement, removal, and packaging of contaminated pumps in accordance with DOE Order 6430.1A, Section 1300-11.2.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.8.b.

e. **Requirement**: Pump cavities that are in contact with liquid waste should be fully drainable and accessible for remote flushing and/or decontamination.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.8.c.

f. **Requirement:** All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Sections 0110-99.0.1, 0205-2, and 1300-11.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.8.a.

g. **Requirement**: Internal and external cracks, crevices, and hold-up points shall be minimized to facilitate pump cleanup for disposal.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.8.e.

3.2.2 ALARA

a. **Requirement:** The radiological design review process of RPP-PRO-1622 shall be used to keep personnel exposures ALARA.

Basis: This requirement is HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.6.1.a.

3.2.3 Nuclear Criticality Safety

N/A

3.2.4 Industrial Hazards

None identified at this time.

3.2.5 Operating Environment and Natural Phenomena

a. **Requirement:** The transfer pump shall be able to withstand the thermal shock of a 38°C (100°F) temperature difference, corresponding to insertion of a cold pump in a hot tank and the use of cold flush/dilution water into a hot pump.

Basis: This requirement is HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.4.b.

b. **Requirement:** The system shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.1.a.

c. **Requirement:** The system shall be designed to withstand the natural phenomena hazards as specified in RPP-PRO-097. The system does not have to operate after a design basis earthquake; it only needs to be removable from the tank.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.1.b.

d. **Requirement:** Prior to installation of a transfer pump, it shall be verified that no interferences exist below the riser that would prevent full insertion of the pump.

Basis: This requirement is per RPP-5982, Elimination of Retrieval Risks Caused by Structural Variations and Debris in Tanks, Rev 0. Certain tanks are known to have failed equipment (i.e., pumps, cables, pipe, etc.), lying on the tank bottom.

e. **Requirement:** The in-tank temperature range for transfer pump design is 10 to 104° C (50 to 220°F).

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.4.b. Note: W-521 will not meet requirement as waste would boil at referenced temperature. CHG to revisit specification requirement.

f. **Requirement:** The DST Transfer Pump Subsystem shall be physically supported by the DST Confinement Subsystem.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.1.2.1.3.a.

3.2.6 Human Interface Requirements

a. **Requirement:** Operator response is required to shut down the transfer pumps if an interlock is not provided for automatic shutdown of transfer pumps in the event of a leak detector alarm.

Basis: This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements Bases, Section B3.1.3.

3.2.7 Specific Commitments

There are no specific commitments identified at this time.

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

a. **Requirement:** Dome loading evaluation shall be performed in accordance with HNF-IP-1266

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.6.2.a.

b. **Requirement:** Fabricate structure steel in accordance with AISC specifications.

Basis: Good Engineering Practice.

3.3.2 Mechanical and Materials

a. **Requirement:** The Transfer Pump System design shall be self-venting. The Transfer Pump shall tolerate reverse rotation or shall be provided with an anti-reverse device if reverse rotation is unacceptable.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev 0, Section 3.1.2.1.1.b.*

b. **Requirement:** The Transfer Pump System pressure boundaries shall have a design pressure rating no less than the maximum pressure of the pump at shutoff when it is pumping fluid of the highest specific gravity specified herein.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.4.a.*

c. **Requirement:** The Transfer Pump System shall accept and route diluent to the pump suction intake. The Transfer Pump System shall be capable of routing water to the pump suction at 100 gal/min (6.3 L/s).

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.5.*

d. **Requirement:** The transfer pump nozzles shall be of the Plutonium-Uranium Extraction (PUREX)-type design in accordance with drawings H-2-90185 and H-2-90186.

Basis: *This requirement is HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.2.a.*

e. **Requirement:** Transfer pump components below the riser flange shall have a maximum diameter of 1-in. (2.54 cm) less than the nominal diameter of the riser in which the transfer pump is to be installed. Maximum diameter shall be measured on either the installed or insertion configuration, whichever is greater.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.2.b.*

f. **Requirement:** The Transfer Pump System design shall minimize the accumulation of solids where process lubricated bearings and mechanical seals are used. The pump should have the capability of flushing such areas.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.4.c.*

g. **Requirement:** Lifting bails shall be provided that enable handling of the transfer pump in the horizontal and vertical positions, while allowing straight vertical insertion of the system into the DST.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.2.c.*

h. **Requirement:** The transfer pump shall be capable of being lifted to an upright position from a horizontal position by a crane from a single point on the mounting flange end without damage to the pump or its components. A tool may be provided, as necessary, to assist uprighting operations.

Basis: *This requirement is per engineering judgment.*

i. **Requirement:** The Transfer Pump System shall avoid the potential for waste leakage due to seal failure above the pump riser flange and direct any potential leakage back into tanks.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.2.f.*

j. **Requirement:** The pump shall remain removable from the tank following a gas release, rollover event and crust impact.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.3.a.*

k. **Requirement:** Transfer pumps Types 2 and 3 shall operate while under the loads induced by the mixer pump described in HNF-4164.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.3.b.*

l. **Requirement:** Transfer pumps shall be designed to withstand shock and vibration conditions encountered during normal transportation via truck or train with no damage to components.

Basis: *This requirement is HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.6.*

m. **Requirement:** To the extent practical, transfer pump designs shall be standardized to allow use in multiple tanks.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.7.*

n. **<u>Requirement</u>:** All transfer pumps shall meet the applicable design, fabrication, dynamic balancing, and testing requirements contained in API 610. The highest degree of dynamic balancing shall be specified.

<u>Basis</u>: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Sections 3.3.1.a., and 4.1.2.a.*

o. **<u>Requirement</u>:** All pump connections that are required to be welded shall be done so in accordance with AWS D1.1 or ASME B31.3 for piping.

<u>Basis:</u> *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.1.b.*

p. **<u>Requirement</u>:** Pump rotation arrows shall be marked on the top of the motor bell housing. This does not apply if a submerged motor pump is selected.

<u>Basis</u>: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.3.d.*

q. **<u>Requirement</u>:** The subsystem components shall be designed to perform their intended function in the chemical environment defined in *Best-Basis Inventory* (database).

<u>Basis:</u> *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.1.*

3.3.3 Chemical and Process

a. **<u>Requirement</u>:** Components contacting waste shall be designed to perform their intended function in the chemical environment defined in *Best-Basis Inventory* (database).

<u>Basis:</u> *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.5.2.1.*

3.3.4 Electrical Power

Detailed electrical power requirements that pertain to the Transfer Pump System are found in W-521-SDD-02, Rev. 2, *Electrical/Water Utilities System Design Description*.

a. **<u>Requirement</u>:** The transfer pump shall be supplied with 480 Vac, 3-phase, 60 Hz, electric power. This shall also provide the capability to control pump speed.

<u>Basis:</u> *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.1.2.1.2.a.*

b. **Requirement:** The Transfer Pump System shall provide, fixed, non-rotating, environmentally protected field terminations that comply with applicable *National Electric Code* (NFPA 70) requirements for all power and signal connections and grounding lug.

__Basis:__ This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.2.d.

c. **Requirement:** Electrical equipment enclosures shall meet National Electrical Manufacturers Association (NEMA) standards.

__Basis:__ This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.2.e.

3.3.5 Instrumentation and Control

The Transfer Pump System shall measure pump equipment parameters including the pump speed (if variable speed drive is utilized).

Detailed instrumentation and control requirements that pertain to the Transfer Pump System are found in W-521-SDD-04, Rev. 2, *Retrieval Control System Design Description.*

a. **Requirement:** Transfer pump motor amperage indication shall be provided on the DST Monitoring and Retrieval Control System display.

__Basis:__ This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.6.6.

b. **Requirement:** For those transfer pumps required to pump supernatant, dissolved salts, and suspended solids, the DST Transfer Pump System shall monitor the position of the transfer pump suction.

__Basis:__ This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.6.a.

c. **Requirement:** The Transfer Pump System shall monitor pump-operating parameters and shall be capable of providing the necessary interfaces with the pump interlock subsystems of the DST Monitoring and Retrieval Control System.

__Basis:__ This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.1.6.c.

d. **Requirement:** The system shall comply with electromagnetic radiation emission requirements set forth in HNF-2962.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.2.*

3.3.6 Computer Hardware and Software

N/A

3.3.7 Fire Protection

N/A

3.4 Testing and Maintenance Requirements

3.4.1 Testability

a. **Requirement:** Whenever possible, instruments that can be operated without calibration or maintenance throughout the design life of the system or component should be selected.

Basis: *This requirement is per Draft HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis, Volume 4, Waste Feed Delivery Operations and Maintenance Concepts, Section 3.5.*

3.4.2 TSR Required Surveillance

TSR Surveillance requirements are as follows:

a. **Requirement:** Service Water Pressure Detection Systems shall be operable within 72 hours prior to removing an administrative lock from a physically connected waste transfer pump.

Basis: *This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, TSR 3.1.2.1.*

b. **Requirement:** Verify that the active primary tank ventilation system is operable every 24 hours.

Basis: *This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, TSR 3.2.1.1.*

c. **Requirement:** The WASTE temperature shall be verified once every 10 days to be:

1. 195°F in all levels of the waste, or
2. 195°F in the top 15 ft. of the waste, or
3. 215°F in the waste below 15 ft.

Basis: *This requirement is per HNF-SD-WM-TSR-006, Rev. 1, Tank Waste Remediation System Technical Safety Requirements, Section 3.0, TSR 3.3.2.1. This requirement is applicable since one of the required actions is to "Stop all transfers to and from the affected tank."*

3.4.3 Non-TSR Inspections and Testing

N/A

3.4.4 Maintenance

Motors for line-shaft driven transfer pumps shall be provided with a manual pump shaft/impeller rotation device and shall be installed such that manual shaft rotation can be performed without removing the pump pit cover blocks.

The equipment design shall minimize the time required to physically disconnect, remove, and replace the transfer pump.

The equipment design shall allow access to maintainable components for repair and/or troubleshooting.

a. **Requirement:** Preventive and predictive maintenance shall be performed to maintain the equipment and its support systems in a satisfactory operable condition throughout the design life. The different types of activities include motor winding continuity and resistance checks, periodic pump "bumping" during extended periods of inactivity, oil analysis and/or replacement, etc. Transfer pumps shall be designed to minimize the amount of periodic maintenance needed.

   Basis: *This requirement is per HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis, Volume 4, Waste Feed Delivery Operations and Maintenance Concepts, Section 3.5.*

3.5 Other Requirements

3.5.1 Security and Special Nuclear Material Protection

N/A

3.5.2 Special Installation Requirements

When possible, transfer pump installation should follow tank contents mixing so that the transfer pump doesn't hang up on solids layer.

3.5.3 Reliability, Availability, and Preferred Failure Modes

a. **Requirement:** The Transfer Pump System shall have a minimum design life of 5,000 hours of operation over a 10-year period. The DST Transfer Pump Subsystem shall be designed for five years without maintenance that would require removal of the pump pit cover blocks.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.4.a.*

b. **Requirement:** Waste transfer pump manufacturer shall provide written recommendations of operational practices such as bumping and flushing to maximize the pumps useful life.

Basis: *This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.2.3.b.*

c. **Requirement:** Reliability, Availability, and Preferred Failure Modes –The Retrieval/Transfer Pump System shall fail in a safe mode or process configuration under a loss of power or off-normal conditions. Transfer pump failure shall not cause collateral damage to the riser or pump pit, or equipment internal to the pit, or harm personnel, or fail in such a way as to prevent removal of the pump from the tank.

Basis: *This requirement is per HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis, Volume 4, Waste Feed Delivery Operations and Maintenance Concepts, Section 3.5.*

d. **Requirement:** Retrieval/Transfer Pump System seals or other design features shall be provided to prevent a pathway for tank waste liquids or gasses to the environment. The Pump System shall contain waste leakage below the pit cover blocks and direct any potential leakage back into the tank.

Basis: *This requirement is per HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis, Volume 4, Waste Feed Delivery Operations and Maintenance Concepts, Section 3.5.*

e. **Requirement:** The Retrieval/Transfer Pump System should have as few external support systems as necessary to minimize the number of systems and components that could fail or could require preventive or corrective maintenance.

Basis: *This requirement is per HNF-1939, Rev. 0, Waste Feed Delivery Technical Basis, Volume 4, Waste Feed Delivery Operations and Maintenance Concepts, Section 3.5.*

3.5.4 Quality Assurance

Vendor information shall be managed in accordance with HNF-IP-0842, Volume IV, Section 4.2.3.

It shall be demonstrated that the transfer pump assembly, when suspended, hangs plumb such that it can be inserted into or removed from the tank riser without interference with the riser.

Pump insertion into and removal from the tank shall be demonstrated for each pump type.

Transfer pumps that have been stored for one year or longer shall be subjected to a run-in test before they are inserted in the waste tank, unless waived by the RPP Design Authority or the RPP Project Manager.

Quality Assurance requirements are as shown in the Master Equipment List (MEL).

3.5.5 Miscellaneous

a. **Requirement:** New equipment and/or modifications to existing equipment shall be labeled in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.3.a.

b. **Requirement:** Transfer pumps shall be provided with a manufacturer's nameplate securely attached to the top of the mounting/adapter flange. The nameplate shall be stamped with the following information at the minimum:

- Purchase order number,
- Manufacturer's size and model number,
- Pump serial number,
- Capacity,
- Pumping head,
- Casing hydrostatic test pressure,
- Rated speed,
- Rated power (if pump has submersible-type motor),
- Bearing part number identification, and
- Assembly weight (dry).

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.3.b.

c. **Requirement:** Electric motors shall conform to NEMA MG-1 standards.

Basis: This requirement is per HNF-4162, Double-Shell Tank Transfer Pump Subsystem Specification, Rev. 0, Section 3.3.3.c.

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

The Transfer Pump System consists of five primary elements including a motor, pump, monitor and control equipment, suction level adjustment, and diluent addition/flushing. Figures 2-1 and 2-2 provide a representation showing key elements. The following sections provide brief descriptions of each element.

4.1.1 Description of System, Subsystems and Major Components

4.1.1.1 Motor

Electric motors provide the motive force for transfer pumps. Motors are approximately 60 hp, 480V 3 phase. A variable frequency drive makes possible a wide range of rotational speeds. Motors are hermetically sealed submersible motors. Motor shaft will be integral with the pump shaft.

4.1.1.2 Pump

The current plan is to use a pump similar to the New Generation Transfer Pump for transfers from all tanks for Project W-521. This pump is a canned-motor centrifugal, diffuser-type pump. Primary components of the pump include the pump casing mounting flange (or volute), impeller, shaft, bearings, and discharge column (or piping). The pump will not include mechanical seals.

Pump diluent, flush, and discharge will be configured to route diluent or flush water to the pump at the appropriate location inside the pump. The DST Transfer Valving System can be configured to route the pump discharge back into the DST or to a waste transfer line.

4.1.1.3 Pump Monitoring & Control

The type and extent of supervisory instrumentation suitable for a given pump installation is based on the pump application, the pump design and size, experience with similar equipment, and the vendor recommendations. For pumps with integral suction height adjustment circuitry, the DST Monitoring and Retrieval Control System shall provide a command signal directly to the Transfer Pump System to move the pump suction up or down. Other instrumentation and control parameters will be defined as the design progresses.

4.1.1.4 Pump Suction Level Adjustment

The pump suction level adjustment supports the decanting transfer of tank supernate liquids, dissolved salts, and suspended solids from tanks without removing the bulk solids. This is accomplished by providing means for the pump suction to be taken at a specified level (above the settled solids). It also allows pumping to within 10 inches of the tank bottom to accommodate total tank transfers. Section 4.1.3 provides further information including indication of the types of transfers that are currently planned for the pumps within the scope of this SDD.

4.1.1.5 Diluent Addition/Flushing

Piping and distribution devices are provided to add treated water to: 1) flush internal pump components, 2) flush transfer lines after waste a transfer is stopped, and 3) dilute the waste entering the pump suction. Piping will be sized for functions 2 and 3 to provide flows up to 100 gpm flow capacity to the pump suction.

4.1.2 Boundaries and Interfaces

The Transfer Pump System interfaces with the Valve, Jumper, Manifold System; Electrical/Water Utilities System; Retrieval Control System; and the Tank Containment Boundary (see Figure 4-1). Waste discharges from the pump and interfaces with the Valve, Jumper, and Manifold System at a Purex –type connector mounted on or near the pump head assembly. Diluent connections are made at one or more valved tube/pipe connection(s) mounted on the pump head assembly within the pump pit. An electrical pigtail from the pump motor interfaces with the electrical system outside the pit at a plugged connection. Instruments located on or in the pump and motor interface with the Monitor & Retrieval Control System at connection points on the pump head assembly. The pump head assembly is sealed and attached to a riser (part of the Tank Containment Boundary) in the pump pit.

4.1.3 Physical Location and Layout

Transfer pumps will be installed in all of the DSTs that are within the scope of Project W-521. The pumps will be installed in the central pump pit in a 42-in. riser. Table 4-1 provides a summary of the pump type and location at each tank.

Table 4-1. Summary Transfer Pump Installation Data

LOCATION	WASTE TYPE	TANK FUNCTION	TRANSFER TYPE	PUMP TYPE	RISER NUMBER	RISER SIZE
AW-101	LAW	Source	Supernate & Dissolved solids	Decant & Full Length	Riser 12	42"
AW-103	HLW	Source	Total Tank	Full Length	Riser 12	42"
AW-104	LAW/HLW	Source & Staging	Supernate & Total Tank	Decant & Full Length	Riser 12	42"
AY-101	HLW	Source & Staging	Supernate & Total Tank	Decant & Full Length	Riser 6a	42"
AY-102	HLW	Source & Staging	Supernate & Total Tank	Decant & Full Length	Riser 6a	42"
SY-101	LAW	Source	Supernate & Total Tank	Decant & Full Length	Riser 13	42"
SY-102	HLW	Source	Supernate & Total Tank	Decant & Full Length	Riser 013	42"
SY-103	LAW	Source	Supernate & Total Tank	Decant & Full Length	Riser 13	42"

4.1.4 Principles of Operation

Following is a basic operational overview of the major components of the Transfer Pump System.

To initiate and sustain waste transfers, diluent will be supplied by the Diluent and Flushing System to flush the transfer pump suction and internal flush ports before pump startup to desaturate salt solutions, dissolve incidental solids that may have formed in the pump, and maintain a clear flow path into the pump suction. If necessary, transfer lines may be pre-conditioned by warming them with heated diluent to prevent solids precipitation during waste transfers.

If a decent operation is being performed, the transfer intake level will be adjusted to keep the pump suction submerged in fluid as deep as possible to prevent cavitation and vortexing while minimizing solids being drawn into the waste stream being pumped.

The diluent flow rate will be adjusted to be a predetermined value and the transfer pump started and adjusted to achieve the desired flow rate. Pump speed is adjusted by means of a variable frequency drive. With the pump on, the diluent can either be recirculated to the top of the waste in the source tank or directed through the transfer lines to the destination tank. Transfer pump and waste parameters will be monitored to assure proper operation and to alert operators to potential problems. To initiate the waste transfer, diluent flow will be reduced in steps while the pump outlet flow rate is adjusted as necessary by increasing or decreasing the pump speed. This function can be performed automatically or manually. As diluent flow is reduced, waste will be drawn into the pump suction to make up the difference. A minimum ratio of diluent to total pump flow will be determined to maintain the transfer stream solids content and/or specific gravity below the allowable limit and prevent transfer line plugging.

When the transfer is complete, if an adjustable suction pump is being used, flush solution flow will be increased the pump suction at a flow rate slightly higher than the pumping rate to flush waste from the suction line, transfer pump, and transfer line. The transfer pump will be shut off and the system is flushed using the Diluent and Flush System. Alternately, the transfer pump will be shut down and the Diluent Flush System will be used to flush transfer lines and back-flush the pump. The flush solution in the transfer line will partially drain to the staging tank and the remainder back to the source tank through the pump. The transfer route will then be reconfigured by returning the transfer valves, diluent and flush solution supply, and pump and monitoring systems to their off-line positions and settings.

4.1.5 System Reliability Features

Reliability features will be defined as the design develops.

4.1.6 System Control Features

System control features will be defined as the design develops.

4.1.6.1 System Monitoring

Transfer Pump System primary operating parameters such as pump speed, discharge pressure, flow rate, etc. will be remotely monitored on the Central Monitor and Control System.

4.1.6.2 Control Capability and Locations

Control capability and locations will be defined as the design progresses.

4.1.6.3 Automatic and Manual Actions

Most actions associated with the system will be performed manually (i.e. STOP/START). Pumps will automatically shut down upon activation of leak detector alarms originating in associated pits other leak detectors and upon activation of pressure switches when increased pressure is sensed between the flush system and the transfer piping system. Normally, pump speed will be automatically adjusted to maintain the specified critical flow velocity.

4.1.6.4 Setpoints and Ranges

Setpoints and ranges will be defined as the design progresses.

4.1.6.5 Interlocks, Bypasses and Permissives

These controls will be defined as the design develops.

4.2 Operations

The WFD Operations and Maintenance (O&M) Philosophy provides the project with constraints and guidance on system operations and developing operations procedures. The O&M Philosophy and the WFD O&M Concept (HNF-1939) are the primary bases for developing the Project Operations Plan. The O&M Concept is strongly influenced by the primary interfaces with the WTF. System design and operation is optimized to support availability, reliability, and accommodate parallel processes where appropriate. Most of the concepts in the O&M Philosophy are related to keeping the WFD systems operating while supplying feed to the WTF and minimizing the shutdown time necessary for maintenance and repairs.

Prior to the initial system startup, readiness to start-up will be verified to meet the intent and requirements of the PHMC procedure for facilities startup and readiness, RPP-PRO-55 "Facilities Start-Up Readiness" which implements U.S. Department of Energy (DOE) Order 425.1, *Startup and Restart, of Nuclear Facilities*. The level and type of review will be conducted at the lowest practical level commensurate with the project safety risk.

4.2.1 Initial Configuration (Pre-Startup)

The configuration prior to system startup will be such that only those valves, breakers and switches necessary to ensure a safe shutdown condition will have to be realigned. Operators in the field and in the control area should have the least number of components to reconfigure as possible. This reduces the likelihood that a critical component will be placed or remain in an improper position. Prior to each system startup, a thorough, step-by-step procedure will be used to place the system in the proper configuration for startup. This procedure will incorporate independent verification steps for all critical steps.

4.2.2 System Start-up

Using the approved startup procedure, operators will start the system remotely from the control area. The system is not designed to be started or operated from the field since all required parameters are not available for monitoring. After system parameters reach steady state conditions that the operators will progress to a normal monitoring operations mode.

4.2.3 Normal Operations

After all system parameters reach steady state conditions, the operators will perform routine monitoring. Routine monitoring consists of recording parameters on data sheets. In order to ensure that the control area operators are not distracted, it is recommended that they have no other duties other than to operate and monitor the transfer pump system.

The control and operation of transfer pumps will take place from a remote, centralized monitoring and control station. All critical parameters and their associated alarms will be monitored from this central location. Certain alarms and conditions may require operators to go to the field for investigation. Critical operating parameters that could cause damage if limits are exceeded will provide alarms prior to exceeding these limits in order to allow the operators to take corrective action before the equipment shuts down automatically.

4.2.4 Off-Normal Operations

Off-normal operations will be covered in the applicable operating and emergency response procedures. Generally, the response to any off-normal situation will be to place the system in a safe, shutdown condition if operator initial response does not mitigate the situation. The on-duty operators may perform this shutdown in a controlled manner manually from the control area, or it may occur automatically, depending on the speed necessary to place the system in a safe condition.

4.2.5 System Shutdown

The Transfer Pump System will normally be shutdown from the control area. The system will be placed in such a condition so as to facilitate future startups while maintaining the facility in a stable shutdown status. After normal pump operations, a system and transfer line flush and pump backflush will be performed to prevent waste from hardening in transfer lines as well as in pump internals.

4.2.6 Safety Management Programs and Administrative Controls

Personnel access to the pump and valve pit areas during transfers will be limited initially to minimize possible radiation exposure due to increased levels in these pits while waste is moving through them. Once enough data has been recorded to ensure personnel safety, unrestricted access may be restored.

4.3 Testing and Maintenance

Systems are designed to be as reliable as possible with little or no preventive maintenance or testing. The higher initial costs associated with the more robust New Generation Transfer Pump (NGTP) will be recovered through reduced down time, repairs, and avoiding contractual costs from the inability to provide feed to the privatization contractor. The Operations Plan and Operations Procedures are developed in coordination with interfacing projects to ensure a consistent O&M concept is implemented for all waste retrieval systems supporting WFD.

Since the installation of the transfer pumps will most likely occur several months prior to their initial operation, it will be necessary to perform periodic maintenance activities to reduce the risk of shaft seizure. This can be done by bumping the pumps and by periodic flushing. Using the pump's motor to rotate the shaft to ensure all built-up deposits between the rotating and non-rotating elements are broken up is called "bumping." Since the pumps cannot be bumped until their readiness is verified, periodic flushing will have to be performed. After readiness has been verified and after operation, the pumps should be bumped regularly to ensure the shaft and bearings do not seize.

4.3.1 Temporary Configurations

In order to perform some maintenance and testing activities, it may be necessary to align the system other than that for normal operations. Any situations requiring temporary configurations will be controlled via formal work procedures to ensure normal system configuration is restored when the maintenance or testing activity is complete.

4.3.2 TSR-Required Surveillance

The TSR Required Surveillance related to maintenance and testing for the retrieval/transfer pump systems are as follows:

- TSR 3.1.2.1 (verify that service water pressure detection systems are operable) – once within 72 hours prior to removing an administrative lock from a physically connected waste transfer pump.
- TSR 3.1.2.2 (Perform functional test on the service water pressure detection systems and verify a setpoint of $\leq$ 20 lb/in^2 gauge on increasing pressure – 365 days. This SR is applicable since there will be a dilution/flush system connected to the mixing pumps that could be subjected to pump discharge pressure and possibly become contaminated with tank waste.
- TSR 3.1.3.1 (Perform functional test on conductivity probe transfer leak detection systems) – once within 92 days prior to removing an administrative lock from a physically connected waste transfer pump and once per 92 days thereafter. This SR applies to all leak detectors installed in valve and pump pits along the designated transfer route and for all physically connected waste tanks.

4.3.3 Non-TSR Inspections and Testing

This category consists mostly of preventive and predictive maintenance designed to maintain the equipment and its support systems in a satisfactory operable condition throughout their design life.

4.3.4 Maintenance

4.3.4.1 Post Maintenance Testing

Post maintenance testing is conducted to ensure maintenance is properly performed and the identified/original deficiency is corrected. Upon completion of a maintenance activity, testing will be performed to ensure the equipment is restored to an operational status. The rigor of post maintenance tests will be based on the extent of preventive and/or corrective maintenance performed and the importance of the equipment to plant/system safety and reliability.

4.3.4.2 Post Modification Testing

Post modification testing is essentially the same as post maintenance testing. It is performed to ensure that the safety related functions of a system still perform satisfactorily after the system or equipment has been modified. Post Modification Testing is performed in accordance with the same guiding documents used for Post Maintenance Testing.

VALVE/PUMP PITS AND COVER BLOCKS SYSTEM DESIGN DESCRIPTION

prepared for

CH2M HILL HANFORD GROUP, INC.
Contract No. 4412, Task 00008
Report No. W-521-SDD-08
Revision 2

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Prepared by: Chip Conselman, P.E.

Approved by: R L Fritz
Robert L. Fritz

Date: 9-30-00

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Acronyms

AC	Administrative Controls
ACI	American Concrete Institute
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society Of Mechanical Engineers
AWS	American Welding Society
COB	Cleanout Box
DCRT	Double Contained Receiver Tank
DOE	U.S. Department of Energy
DST	Double-Shell Tank
FSAR	Final Safety Analysis Report
GS	General Service
HNF	Hanford Nuclear Facility
HNF-PRO	Project Hanford Management Contract Procedure
I&C	Instrument and Control
ICS	Industrial Controls and Systems
LCO	Limited Conditions for Operation
O&M	Operations and Maintenance
RPP	River Protection Project
SC	Safety Class
SDD	System Design Description
SPC	Special Protective Coating
SS	Safety Significant
SSC	Structures, Systems, and Components
TBD	To be determined
TBR	to be refined
TSR	Technical Safety Requirements
TWRS	Tank Waste Remediation System
WAC	Washington State Administration Code
WBS	Work Breakdown Structure
WFD	Waste Feed Delivery
WFDS	Waste Feed Delivery System
WTF	Waste Treatment Facility
VPI	Valve Position Indicator

1.0 INTRODUCTION

This System Design Description (SDD) identifies performance requirements, defines bases, and provides references to requisite codes and standards to the Waste Feed Delivery System (WFDS) Project, W-521 for the transfer-associated structures (Valve/Pump Pits and Cover Blocks). This revision incorporates requirements as specified in HNF-4160, Rev. 0, *Double-Shell Tank Transfer Valving Subsystem Specification.*

1.1 System Identification

There are four primary elements constituting the transfer-associated structures subsystem. These elements are:

- Process pits (valve and pump),
- Process pit cover blocks,
- Mixer pump support/mounting structures, and
- Miscellaneous support structures.

1.2 Limitations

This SDD is limited to the waste tanks that are within the scope of the WFDS Project, W-521. Those farms within the project scope requiring transfer-associated structures are: AP Farm, AW Farm, AY Farm, and SY Farm.

This SDD describes the project-installed pit(s), cover blocks and support structures. It is intended to describe those modifications made by project W-521. Interfacing systems will be described to the extent necessary to define the interface boundaries, whether within or outside the project boundaries.

This SDD revision was prepared in conjunction with the Advanced Conceptual Design (ACD) Phase of the WFDS Project W-521. Many of the sections contain information that is preliminary, or of a conceptual nature. This SDD will be a living document throughout the design phases of W-521, and will become more detailed as the design progresses through definitive design. Requirements were taken from the *Double-Shell Tank Transfer Valving Subsystem Specification*, HNF-4160, Rev. 0. The previous revision was based on the Draft Level 2 Specifications.

1.3 Ownership

This SDD is owned by the Project Engineer responsible for the Valve/Pump Pits and Cover Blocks.

1.4 Definitions

Administrative Lock – A locking device that prevents an inadvertent equipment start. Administrative locks ensure that the equipment or systems(s) being isolated and/or controlled cannot be operated (e.g., removing the motive force of a transfer pump [e.g., electrical power, steam, water, or air] and installing an administrative lock so that the transfer pump cannot be activated) until the administrative lock is removed.

General Service (GS) SSC – Structures, systems, or components (SSCs) not classified as either Safety Class or Safety Significant.

Manifold – Remotely installed rigid piping system inside a pit that transfers waste and flush water between nozzles.

Physically Connected - Refers only to piping, tanks, and structures and their associated instrumentation.

- Physically connected piping is any piping that is part of or connected to the transfer route. Piping need not be considered connected to the transfer route if it is physically disconnected as described below.

    - An air gap (e.g., removal of piping, transfer jumper) is considered to physically disconnect piping on either side of the air gap; or
    - A blind flange/process blank in the transfer route is considered to physically disconnect piping on either side of the blind flange or process blank; or
    - An operable service water pressure detection system is considered to physically disconnect piping downstream of the first or second closed isolation valve of the detection system that is downstream of the source of pressurized WASTE, depending on how the system pressure boundary integrity is tested (see HNF-SD-WM-SAR-067, Chapter 4.0); or
    - An OPERABLE backflow prevention system in the 204-AR Waste Unloading Facility is considered to physically disconnect piping downstream of the second isolation valve that is downstream of the source of pressurized WASTE; or
    - Two Safety – Significant isolation valves, INDEPENDENTLY VERIFIED to be in the closed position, are considered to physically disconnect piping on the downstream side of the second closed isolation valve that is downstream of the source of pressurized waste.

    (**Note**: Closed valves that are not designated as Safety-Significant do not physically disconnect piping from the transfer route).

- The East/West cross-site transfer line and replacement cross-site transfer lines are considered PHYSICALLY CONNECTED piping only when cross-site WASTE transfers are in progress. The East/West cross-site transfer line is the piping between 241-UX-154 diversion box and 241-ER-151 diversion box. The replacement cross-site transfer line is the piping between 241-SY-A and 241-SY-B valve pits and the 244-A lift station.

- PHYSICALLY CONNECTED structures are those structures through which PHYSICALLY CONNECTED piping runs, or structures that could be subject to leakage from PHYSICALLY CONNECTED piping.

- PHYSICALLY CONNECTED tanks are those tanks connected to the transfer route, those tanks connected to the PHYSICALLY CONNECTED piping, and those tanks designed to receive leakage from PHYSICALLY CONNECTED piping through a drain path.

Pit Nozzle – Rigid male connector anchored in the pit wall or the transfer pump housing that provides a leak-tight connection with the integral seal block attached to a manifold.

RPP Design Authority – A person qualified in the practice of engineering with four years demonstrated job related experience including two years in their specific functional areas. For nuclear structures, systems, or components, they shall have at least one year nuclear experience. The River Protection Project (RPP) Design Authorities for the facility and for the Project must have completed the RPP Design Authority Qualification Card and have an appointment letter approved by the RPP Chief Engineer.

Safety Class (SC) SSC – An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or to prevent a nuclear criticality. Those SSCs that support the safety function of a SC SSC may also be SC.

Safety Significant SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) from hazards not controlled by institutional safety programs. Those SSCs that support the safety function of an SS SSC are also SS.

Shall – Denotes a requirement.

Shall Consider – Requires that an objective assessment be performed to determine to what extent the specific factor, criterion, guideline, standard, etc., will be incorporated into or satisfied by the design. The results and basis of this assessment shall be documented. Such documentation shall be retrievable and can be in the form of engineering studies, meeting minutes, reports, internal memoranda, etc.

Should – Denotes a recommendation. If a "should" requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

Tank Opening – Tank risers and pits with an open path to the tank.

TBD – To be determined. A study and/or calculation needs to be performed in order to provide a sufficient technical basis for the requirement.

TBR – To be refined. A "soft" basis for the requirement has been identified. However, a further study and/or calculation needs to be performed in order to solidify the requirement's technical basis.

Transfer-Associated Structure – Pump pits, valve pits, diversion boxes, cleanout boxes, cover blocks and mixer pump support structures.

Waste Feed – Waste slurry to be transferred to the Waste Treatment Facility (WTF) containing a mixture of solids and liquids.

2.0 GENERAL OVERVIEW

2.1 System Functions

The overall mission of the Valve/Pump Pits and Cover Blocks (transfer-associated structures) System is to support other systems in providing a reliable transfer route for delivering waste to the WTF. To accomplish this mission, the Valve/Pump Pits and Cover Blocks System must meet the requirements of this SDD.

2.1.1 Process Pits (Valve and Pump)

The process pits are intended to house the components necessary to direct and control the flow of process fluids within the Double-Shell Tank (DST) system and for delivery to the WTF. The process pits are those structures intended to perform the following functions:

- House the Transfer Valving System (Jumpers), Transfer Pump System, portions of the Mixer Pump System (AY-101 and AY-102 only) and portions of the DST Monitoring & Retrieval Control Systems components;
- Provide secondary containment to the Transfer Valving System, Transfer Pump System, the Mixer Pump System (AY-101 and AY-102 only) and portions of the DST Monitoring & Retrieval Control Systems components;
- Provide radiological shielding from the process fluids to the onsite workforce;
- Accumulate leaked fluids within the pits to a detectable level; and
- Provide drainage path of accumulated/leaked fluids back to the DST.

2.1.2 Process Pit Cover Blocks

Cover blocks are the removable top portion of the process pit. They are intended to perform the following functions:

- Provide access to the Transfer Valving System, Transfer Pump System, the Mixer Pump System (AY-101 and AY-102 only) and portions of the DST Monitoring & Retrieval Control Systems components housed within the pit(s) (for the purposes of removal, maintenance, observation, calibration, etc);
- Provide radiological shielding from the process fluids to the onsite workforce;

- Divert rain water from unnecessarily accumulating within the pit(s); and
- Provide spray leak protection from the process waste stream.

2.1.3 Support Structures

The support structures, including the mixer pump support platforms, are intended to perform the following functions:

- Provide a level, stable platform on which to mount and to support the equipment during periods of inactivity and operations, and
- Distribute the weight of the equipment/assembly over the tank dome.

2.2 System Classification

Table 2-1 identifies the preliminary safety classification of Valve/Pump Pits and Cover Blocks System components as stated in *HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0.* The final classifications will be determined during the safety analysis/permitting process.

Table 2-1. Preliminary Safety Classification of Pits and Cover Blocks System Components

Component	GS	SS	SC
Transfer-associated structure cover blocks			X
Transfer-associated structures	X		

GS = general service
SC = safety class
SS = safety significant

2.3 Basic Operational Overview

The valve boxes and pits are designed for remote operation and are inaccessible during operation. Maintenance is designed to be remote and manned pit entry is permissible only after decontamination. The valve box and pit covers are removable to provide access to the instrumentation, pumps, piping and valves.

3.0 REQUIREMENTS AND BASES

The requirements compiled in this section come predominantly from HNF-4160, *Double-Shell Tank Transfer Valving Subsystem Specification*, Rev. 0.

3.1 General Requirements

This section identifies the general requirements for the DST transfer-associated structures and the bases for these requirements.

3.1.1 System Functional Requirements

a. **Requirement:** Process pits and cover blocks shall have a design life of 35 years.

Basis: This requirement is HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.3.a.

b. **Requirement:** The system shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.3.a.

c. **Requirement:** Tank dome loading shall satisfy the requirements specified in HNF-IP-1266, Chapter 5.16.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.6.2.b.

d. **Requirement:** The subsystem shall be designed in accordance with Washington State Administration Code (WAC) 173-303-640 (3) for final status facilities and 40 CFR 265, Subpart J, for interim status facilities; U.S. Department of Energy (DOE) Order 6430.1A, Section 0262; and DOE Order 5820.2A, Chapter 1, Section 3.b(2)(g). The design of the subsystem shall allow for detection of a leak within 24 hours.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.6.2.a.

3.1.2 Subsystem and Major Components

3.1.2.1 Process Pits

a. **Requirement:** The design of the transfer-associated structure shall be in accordance with WAC 173-303-640 for final status facilities and 40 CFR 265, Subpart J, for interim status facilities. The design of the structure shall allow for detection of a leak within 24 hours.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.1.8.b.

b. **Requirement:** All transfer-associated structures shall be designed to provide the required minimum functions of containment, shielding, and drainage. New transfer-associated structures shall be either welded structural steel per ANSI/AISC N690 or reinforced concrete per ACI 349 (safety class) or ACI 318 (general service or safety significant).

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.1.e.*

c. **Requirement:** The transfer-associated structure drain design shall allow drainage from the pump pits, valve pits, COBs, and diversion boxes to a level below the leak detection sensor position.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.1.l.*

d. **Requirement:** All new process pit (a pit that redirects waste flow) shall be equipped with stainless steel liners that extend to the top of the pit, where the cover block steps start.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.1.m. (Applies to new pits only. Existing pits will have SPC to achieve same function).*

3.1.2.2 Cover Blocks

a. **Requirement:** New cover blocks shall be sloped to allow water to drain off the top of the cover and extend over the outside of the pit walls. Existing cover blocks shall be modified with drip shields or other mechanical means, as required, to meet the requirements of WAC 173-303-640 (4)(e).

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.2.e.*

b. **Requirement:** Cover block penetrations shall be sealed adequately to stop rain/snow water intrusion.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.2.g.*

c. **Requirement:** Cover blocks shall prevent radiation streaming.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.2.h.*

d. **Requirement:** Cover blocks for new pump pits and valve pits shall be sealed to the transfer-associated structure by a compressible gasket.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.1.i.*

e. **Requirement:** Cover blocks shall have a special protective coating to prevent waste absorption from a spray leak.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.1.n.

f. **Requirement:** Cover blocks shall be marked to indicate the center of gravity and weight.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.3.d.

g. **Requirement:** Cover block shall be designed to meet the requirements of the authorization basis.

Basis: This requirement is per HNF-SD-WM-SAR-067, Rev. 1, and HNF-SD-WM-TSR-006.

3.1.2.3 Support Structures

There are no requirements within the specifications that specifically address support or ancillary structures. The general requirements previously specified will be applied using a graded approach to these components/subsystems. For example, pads and foundations shall be designed to comply with the dome loading criteria.

3.1.3 Boundaries and Interfaces

Subsystems that interface with the Valve/Pump Pits and Cover Blocks System are the Mixer Pump System, the Transfer Pump System, the DST Monitoring & Retrieval Control Systems and the Piping, Jumper and Valve System. These interfaces are illustrated in Figure 3-1.

3.1.3.1 Piping, Jumpers and Valves Systems

a. **Requirement:** The Transfer Valving System shall provide local indication of the actual position of all transfer valves. Mechanical indication of the valve's position shall be visible from the top of the cover block.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.1.2.1.b.

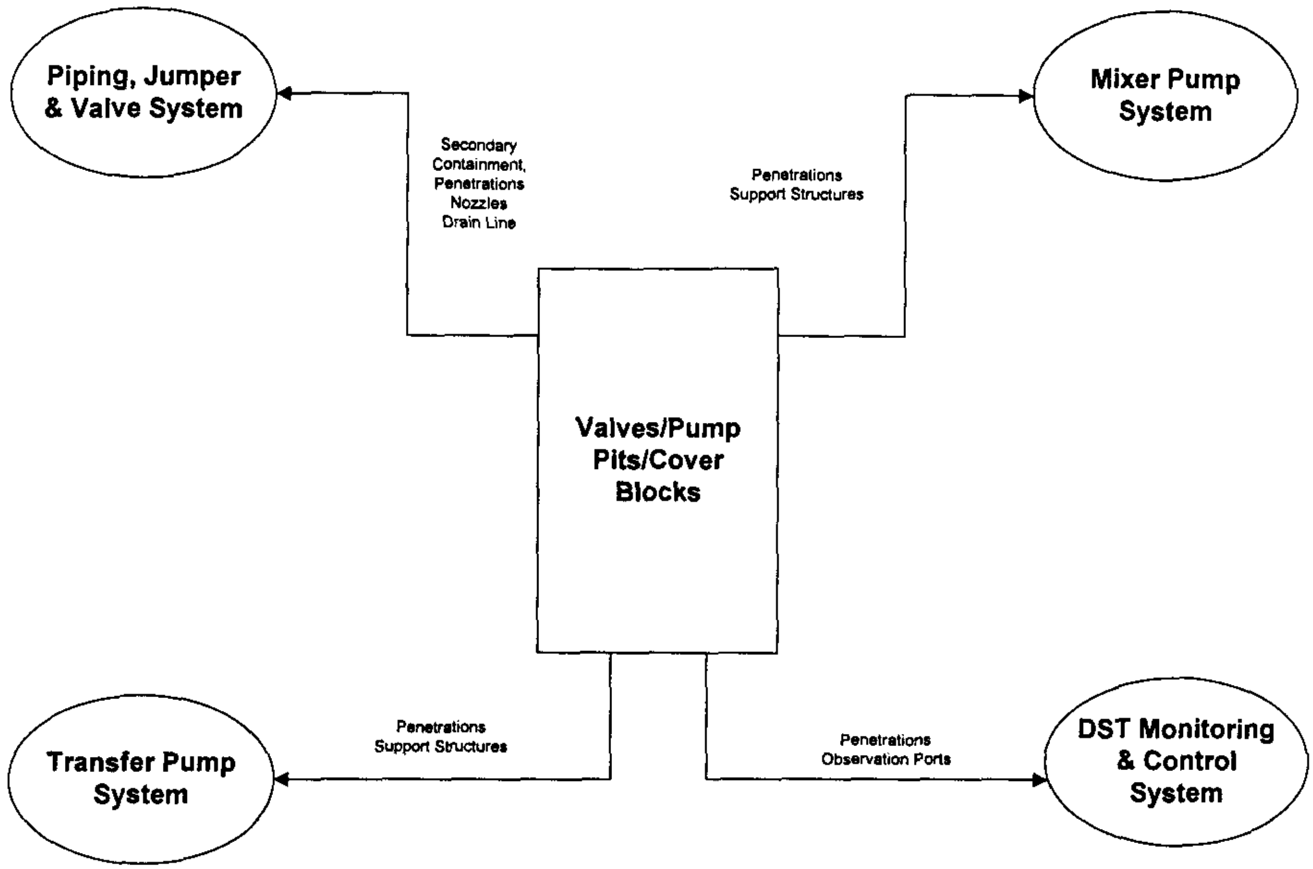

Figure 3-1. Valve/Pump Pits and Cover Blocks System Interfaces

3.1.3.2 Mixer Pump System

a. **Requirement:** The mixer pump support supports the weight of the pump, motor, turntable column, radiation shield plug, and other associated components and maintains tank confinement. The load will be transmitted to the cover blocks for some tanks or to a slab on grade. During installation and removal, the mixer pump support will interface with the impact-limiting system and the flexible receiver.

__Basis:__ This requirement is per HNF-4164, Double-Shell Tank Mixer Pump Subsystem Specification, Rev. 0., Section 3.7.4.

b. **Requirement:** The Transfer Valving Subsystem transfer-associated structure shall contain the leakage from the mixer pump and route it to the tank as required.

__Basis:__ This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.1.2.1.7.a.

3.1.4 Codes, Standards and Regulations

Design requirements applicable to the transfer-associated structures come from government and non-government source documents and various codes and standards. Each document (of the exact revision identified) in this section is invoked by one or more requirements of this specification and represents a part of this specification to the extent specified.

3.1.4.1 Government Documents

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State constitute a part of this specification to the extent specified herein. The regulatory documents that form a part of this specification are listed in Table 3-1.

Table 3-1. Government Documents

Document Number	Title
DOE 5820.2A, 1988	*Radioactive Waste Management,* U.S. Department of Energy, Washington, D.C.
DOE 6430.1A, 1989	*General Design Criteria,* U.S. Department of Energy, Washington, D.C.
DOE/RL-96-109, Rev. 0	*Hanford Site Radiological Control Manual (HSRCM-1),* U.S. Department of Energy-Richland Operations Office, Richland, Washington.
RCRA, 1976	*Resource Conservation and Recovery Act of 1976, 42 USC 6901.*
10 CFR 835	Occupational Radiation Protection, Code of Federal Regulation, dated 11/98, Washington, D.C.

3.1.4.2 Non-Government Documents

National codes, standards, and the Hanford Site documents listed in Table 3-2 constitute a part of this specification to the extent specified herein. Note: The RPP-PROs implement federal and state regulations and DOE orders. In addition, it should be noted that some requirements are based on the existing authorization basis documents (HNF-SD-WM-SAR-067, HNF-SD-WM-TSR-006, etc.). The Authorization Basis requirements may be changed, if necessary, after analysis and justification of the resulting risk being incurred have been outlined in a final safety analysis report (FSAR) amendment and approval is obtained from DOE Office of River Protection. In addition, the list of procedures is not intended to be complete, but rather to identify key ones which, when implemented, will support successful completion of design activities. Specific other procedures/documents are referenced throughout the sections of this document.

Table 3-2. Non-Government Documents

Document Number	Title
AASHTO, H20-44, 1996	*Standard Specification for HS-20, Highway Loading*, American Association of State Highway and Transportation Officials.
ASME B31.3, 1999	*Process Piping*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section V, 1998	*Non-Destructive Examination*, American Society of Mechanical Engineers, New York, New York.
ASME B&PV, Section IV	*Heating Boilers*, American Society of Mechanical Engineers, New York, New York.
ANSI Z358.1-1990	*Emergency Eyewash and Shower Equipment*, American National Standards Institute.
ASME NQA-1, 1994	*Nuclear Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation.*
RPP-PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards.*
RPP-PRO-224, Rev. 0, 1999	*Document Control Program Standards.*
RPP-PRO-700, Rev. 0, 1999	*Safety Analysis and Technical Safety Requirements.*
RPP-PRO-701, Rev. 0, 1999	*Safety Analysis Process – Existing Facility.*
RPP-PRO-702, Rev. 0, 1999	*Safety Analysis Process – Facility Change or Modification.*
RPP-PRO-703, Rev. 0, 1999	*Safety Analysis Process – New Project.*
RPP-PRO-704, Rev. 0, 1999	*Hazard and Accident Analysis Process.*
RPP-PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods.*
RPP-PRO-1622, Rev. 0, 1999	*Radiological Design Review Process.*
RPP-PRO-1819, Rev. 0, 1999	*PHMC Engineering Requirements.*
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2937, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-2962, 1998	*A List of Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC) Requirements*, Numatec Hanford Corporation for Fluor Daniel Northwest for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1 Rev. 1A, 1999	*RPP Administration Tank Farm Operations Equipment Labeling and Master Equipment List Control*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-MP-599, Rev. 3, 1999	*Project Hanford Quality Assurance Program Description*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SEL-040, Rev. 1, 1998	*TWRS Facility Safety Equipment List*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-SP-012, Rev. 1, 1999	*Operations and Utilization Plan*, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-TRD-007, Rev. E Draft, 1998	*System Specification for the DST System*, COGEMA Engineering for Fluor Daniel Hanford, Richland, Washington.

Document Number	Title
HNF-SD-WM-TSR-006, Rev. 0-R, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Richland, Washington.
NACE RP 0169-96, 1996	*Control of External Corrosion Engineers*, Houston, Texas.
HNF-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site*, Washington, Numatec Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-SD-WM-HSP-002, Rev. 3A, 1998	*Tank Farms Health and Safety Plan*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Richland, Washington.
HNF-5183, Rev. 0, 1999	Tank Farms Radiological Control Manual, Fluor Daniel Hanford, Richland, Washington.

3.1.5 Operability

a. **Requirement:** Cover blocks shall have penetrations to facilitate operation and/or functional testing of the components inside transfer-associated structures. Operations include, but are not limited to, decontamination by washdown, removing standing water with a portable pump, retrieving gas and particulate samples, and taking still and motion pictures of valve stem position and of the entire structure interior.

__Basis:__ This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.2.f.

b. **Requirement:** Cover blocks shall be provided with lifting bails suitable for balanced lifting by crane.

__Basis:__ This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.2.i.

c. **Requirement:** Cover blocks and pit walls shall be marked to facilitate alignment of the cover blocks for proper sealing.

__Basis:__ This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.5.1.e.

d. **Requirement:** Transfer system covers shall be operable.

__Basis:__ This requirement is per HNF-SD-WM-TSR-006, LCO 3.1.1, Transfer System Covers and Entry Doors.

e. **Requirement:** A program shall be maintained to manage potential ignition sources that can initiate a fire or flammable gas deflagration.

__Basis:__ This requirement is per HNF-SD-WM-TSR-006, AC 5.10, Ignition Controls.

f. **Requirement:** A program shall be maintained to control waste transfers through the RPP waste transfer systems.

Basis: *This requirement is per HNF-SD-WM-TSR-006, AC 5.12, Transfer Controls.*

g. **Requirement:** A program shall be maintained to control transfer system cover removal.

Basis: *This requirement is per HNF-SD-WM-TSR-006, AC 5.22, Transfer System Cover Removal Controls.*

3.2 Special Requirements

No special requirements have been identified.

3.2.1 Radiation and Other Hazards

a. **Requirement:** The subsystem shall be designed for the 1,000 rad/h radiation environment for direct contact with tank waste as defined in HNF-2004.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.5.2.2.*

b. **Requirement:** The subsystem shall be designed such that access controls to radiation and high-radiation areas meet the requirements of DOE/RL-96-109.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.9.*

c. **Requirement:** Cover blocks shall be designed to align with the transfer-associated structure to prevent the direct release of aerosol to the atmosphere from a spray leak.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.1.8.a.*

3.2.2 ALARA

a. **Requirement:** Transfer associated structure shielding shall be designed to keep personnel exposures as low as reasonably achievable (ALARA) in accordance with RPP-PRO-1621 and RPP-PRO-1622.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.6.1.a.*

b. **Requirement:** All components that may become contaminated with radioactive or other hazardous material under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Section 1300-11.

Basis: *This requirement is per HNF-4160 Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.8.a.*

3.2.3 Nuclear Criticality Safety

N/A

3.2.4 Industrial Hazards

a. **Requirement:** The Transfer Valving Subsystem shall incorporate design features that comply with the requirements of HNF-SD-WM-HSP-002 and other applicable safety and health requirements.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.6.1.b.*

3.2.5 Operation Environments and Natural Phenomena

a. **Requirement:** The subsystem shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501.

Basis: *This requirement is per HNF-4160 Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.5.1.a.*

b. **Requirement:** The subsystem shall be designed to withstand the natural phenomena hazards as specified in RPP-PRO-097.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.5.1.b.*

c. **Requirement:** For permanent structures, subsurface conditions shall be determined by means of boring or other methods that adequately disclose soil and groundwater conditions. Data and other information obtained from prior subsurface investigations may be used, supplemented by additional investigations at the specific location, as deemed necessary by the RPP Design Authority

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.2.5.1.c.*

d. **Requirement:** System and components shall be designed in accordance with the safety classification for each. The safety classification shall be determined using the process described in RPP-PRO-700, RPP-PRO-702, RPP-PRO-703 and RPP-PRO-704, based on the guidelines in HNF-SD-WM-SAR-067, Section 3.0.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.6.3.a.*

3.2.6 Human Interface Requirements

a. **Requirement:** Subsystem design shall comply with DOE Order 6430.1A, Section 1300.12, "Human Factors Engineering."

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.7.*

3.2.7 Specific Commitments

No specific commitments have been identified.

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

a. **Requirement:** All transfer-associated structures shall be designed to provide the required minimum functions of containment, shielding, and drainage. New transfer-associated structures shall be either welded structural steel per ANSI/AISC N690 or reinforced concrete per ACI 349 (safety class) or ACI 318 (general service or safety significant).

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.1.e.*

b. **Requirement:** All structural welds shall be in accordance with AWS D1.1.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.1.h.*

c. **Requirement:** Nuclear and physical property reporting used in concrete radiation shielding design for transfer-associated structures shall comply with ANS 6.4.

Basis: *This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.3.6.1.c.*

3.3.2 Mechanical and Materials

No Mechanical and Materials requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.3.3 Chemical and Process

Any applicable chemical and process related requirements are covered in other portions of Section 3.

3.3.4 Electrical Power

No electrical power requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.3.5 Instrumentation and Control

No instrumentation and control requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.3.6 Computer Hardware and Software

No computer hardware and software requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.3.7 Fire Protection

No fire protection requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.4 Testing and Maintenance Requirements

3.4.1 Testability

a. **Requirement:** All testing of equipment and instruments will have the ability to be performed without having to have personnel access the pits (other than with video cameras for leak tests) or without having to remove any equipment from the pit. Leak detectors and valve position indicators will be designed and installed to maintain remote testing capabilities. This is important from an ALARA standpoint and from a time to perform the task standpoint. Required tests must be able to be performed within their specified periodicity without impacting Waste Feed Delivery operations. This can only be accomplished by not having to remove the equipment and *not* having to perform pit entries.

Basis: *This requirement is per HNF-4553, Operations and Maintenance Philosophy, Section 7.4.*

3.4.2 TSR- Required Surveillance

a. **Requirement:** Verify that covers are operable – Once within 72 hours prior to removing an administrative lock from a physically connected waste transfer pump and once per 10 days thereafter. This TSR applies to cover blocks on all new pits.

3.4.3 Non-TSR Inspection and Testing

No non-TSR requirements have been identified for the Valve/Pump Pits and Cover Blocks System.

3.4.4 Maintenance

a. **Requirement:** Components internal to the transfer associated structures shall be designed to be remotely removed, repaired or replaced, and operated.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.5.1.a.

b. **Requirement:** Components external to the transfer associated structures shall be designed for minimal contact maintenance and hands-on operation.

Basis: This requirement is per HNF-4160, Level 2 Specification for the Double-Shell Tank Transfer Valving System, Section 3.5.1.b.

c. **Requirement:** Cover blocks, valve manifolds, jumpers, and DST addition drop legs shall be provided with lifting attachment points for installation of the assembly into position. Lifting attachment points for valve manifolds, jumpers, and DST addition drop-legs shall be designed such that the assembly can be adjusted to hang plumb within ± 2.54 cm (1-in.) over its length during installation with a crane. Below the hook lifting hardware, if required, shall be designed and provided with the assembly. Design shall be in accordance with ANSI/ASME B30.2 and DOE/RL-92-36.

Basis: This requirement is per HNF-4160, Double-Shell Tank Transfer Valving Subsystem Specification, Rev. 0, Section 3.5.1.d.

3.5 Other Requirements

3.5.1 Security and SNM Protection

No security and SNM protection requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.5.2 Special Installation Requirements

No special installation requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.5.3 Reliability, Availability, and Preferred Failure Modes

No Reliability, Availability, and Preferred Failure Modes requirements are identified for the Valve/Pump Pits and Cover Blocks System.

3.5.4 Quality Assurance

Quality assurance requirements are shown on the Master Equipment List (MEL).

3.5.5 Miscellaneous

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

4.1.1 Description of System, Subsystems and Major Components

The following provides a brief description of the major components of the Valve/Pump Pits and Cover Blocks System.

4.1.1.1 Process Pits

One new process pit will be provided by Project W-521, valve pit 241-AP-A, on the northeast side of the AP Farm. The dimensions of the pit will be sized to adequately contain the required transfer valves, jumpers, and associated subsystems. The elevation of the pit floor will be set approximately 24-in. below the centerline of the lowest incoming transfer piping system to allow for correct nozzle elevation within the pit. The top of the pit wall will be approximately 12-in. above the existing grade. Since the cover block will extend over the pit wall, conduits will be provided in the pit wall above grade (see Figure 4-1). Those conduits not in use will be capped off.

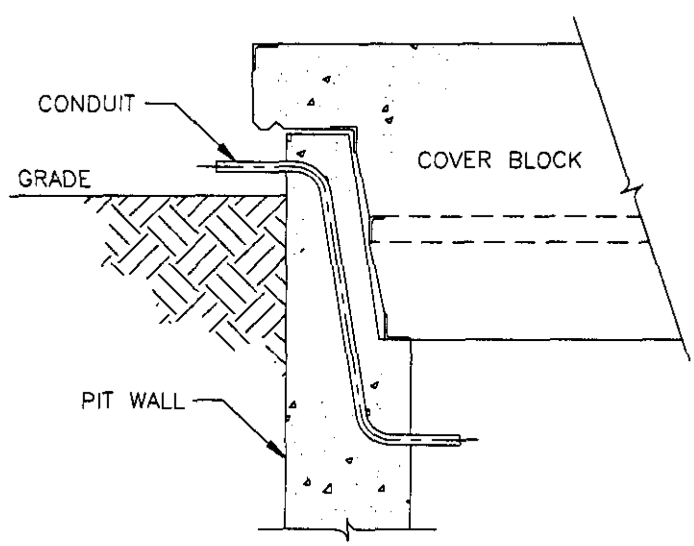

Figure 4-1. Cover Block/Pit Wall Configuration

The floor of the pit will be sloped toward a low point located in a corner of the pit. The pit drain will be located at this low point and will extend through the pit wall, where a tie-in will be made to the DST system. This prevents the pit from becoming a waste container, which would require secondary confinement.

The location and construction of this pit must be coordinated with Project W-314.

In support of the modifications being made to the 241-AY/AZ ventilation system, a new vent cell will be constructed at 241-AZ-702. The vent cell will be approximately 14 ft 6-in. wide by 19 ft long and will extend 11 ft 6-in. above grade (see drawing ESW-521-S4).

4.1.1.2 Cover Blocks

The cover blocks that require significant modifications by interfacing systems will be re-fabricated. The pits where the cover blocks will be replaced are: AW-01A, AW-03A, AW-04A, AY-01A, AY-01B, AY-01D, AY-02A, AY-O2B, AY-02D, SY-01A, SY-02A, SY-03A, SY-A, SY-B and the 241-AP valve pit. Additionally, new cover blocks will be fabricated for the new 241-AP-A valve pit and the 241-AZ-702 vent cell.

The only pits that will require cover block penetrations for mixer pumps are AY-01B, AY-01D, AY-02B, and AY-02D. The exact size and configuration of the mixer pump penetration through the cover blocks will be finalized as the mixer pump design is completed.

Depending upon the design selection of the transfer pump, provisions may have to be made to physically accommodate the size of the contained components. If this is the case, the pit cover block design will be modified preferentially over modification to the pit. Penetrations in the pump pit cover blocks will be made as required for the newly contained systems, with additional ports added for observation and inspection.

The cover blocks will be designed to minimize radiation exposure to the worker, but will not be designed for continual occupancy (per 10 CFR 835.202). Shielding calculations will be performed to ensure radiation levels during the "worst case" transfer will fall below levels producing a "radiation" area (2 mrem/hr). The cover blocks for the existing pits will retain the same design for mating to the adjacent pit walls and other blocks as is currently utilized, with the exception of providing an overhang beyond the pit walls. The size, number, and location of the penetrations will be appropriate for the interfacing component(s) and required observation/inspection ports.

4.1.1.3 Support Structures

Mixer pump support structures will be provided on all of the eight tanks within the project W-521 scope. All of the mixer pumps will be installed in a riser that is not located in a pit, with the exception of tanks AY-101 and AY-102, which will utilize existing pits for mounting of the mixer pumps. A cast-in-place foundation will be situated around each riser, not located within a pit, to support the mixer pumps. These concrete pads will be sized to distribute the load adequately to remain below 40 pounds per square foot. The mixer pump support stand will include a slip flange that will slide into and seal the interface with the existing riser. The stand will support the full weight of the mixer pump and will prevent any of the loads from being transferred to the riser. Additionally, side loading calculations will be performed to ensure no side loading of the riser occurs during mixer pump operations. Each support structure will be coated with a special protective coating.

4.1.2 Boundaries and Interfaces

Subsystems that interface with the Valve/Pump Pits and Cover Blocks System are the Mixer Pump System, the Transfer Pump System, the DST Monitoring & Retrieval Control Systems and the Piping, Jumper and Valve System. Table 4-1 provides a listing of system interfaces.

Table 4-1. Valve/Pump Pits and Cover Blocks System Interfaces

System	Interface	Accommodation
DST Monitoring & Retrieval Control Systems	VPI	• Slots in pit wall
	Electric valve actuation	• Penetrations in cover blocks • Slots in pit wall
	Gauges/Meters	• Slots in pit wall
	Calibration/Inspection	• Observation/Inspection ports
Piping, Jumper and Valve	Pit nozzles	• Penetrations in pit wall
	Drain from valve pits	• Drain tie to piping system drain line
	Inspection	• Inspection ports
	New jumpers and manifolds	• The new 241-AP-A valve pit wills be sized to accommodate the required valving
Transfer Pump	Gauges/Meters	• Slots in pit wall
	Calibration/Inspection	• Observation/Inspection ports
	Mounting	• Integral mounting hardware
Mixer Pump	Calibration/Inspection	• Observation/Inspection ports
	Mounting	• Integral mounting hardware

4.1.3 Physical Location and Layout

New cover blocks will be installed on the majority of the pits that are within the scope of Project W-521. Table 4-2 provides a summary of the pits, their length and width dimensions and the number of cover blocks required.

Table 4-2. Valve/Pump Pits and Cover Blocks System Locations and Dimensions

Pit	Inside Pit Dimensions (Ft)	Number of Cover Blocks
241-AP VALVE PIT	16 X 41	8
241-AP-A VALVE PIT (NEW)	10 X 10	2
241-AW-01A PUMP PIT	8 X 14	3
241-AW-03A PUMP PIT	8 X 14	3
241-AW-04A PUMP PIT	8 X 14	3
241-AY-01A PUMP PIT	8 X 12	3
241-AY-01B SLUICE PIT	6 X 8	2
241-AY-01D SLUICE PIT	6 X 8	2
241-AY-02A PUMP PIT	8 X 12	3
241-AY-02B SLUICE PIT	6 X 8	2
241-AY-02D SLUICE PIT	6 X 8	2
241-SY-A VALVE PIT	10 X 12	2
241-SY-B VALVE PIT	10 X 12	2
241-SY-01A PUMP PIT	8 X 14	3
241-SY-02A PUMP PIT	8 X 14	3
241-SY-03A PUMP PIT	8 X 14	3
241-AZ-702 VENT CELL	N/A	2

4.1.4 Principles of Operation

The Valve/Pump Pits and Cover Blocks System is a static system with no operations activities necessary. Prior to transfer of waste through the valve and pump pits, verification that the pit coverblocks are in place will occur. This activity is required by the authorization basis and will be initiated via approved procedures.

4.1.5 System Reliability Features

No specific reliability features for the design of the components discussed in this SDD have been currently identified.

4.1.6 System Control Features

4.1.6.1 System Monitoring

No system monitoring requirements are identified for the Valve/Pump Pits and Cover Blocks System.

4.1.6.2 Control Capability and Locations

No control capability and locations requirements are identified for the Valve/Pump Pits and Cover Blocks System.

4.1.6.3 Automatic and Manual Actions

No automatic and manual actions requirements are identified for the Valve/Pump Pits and Cover Blocks System.

4.1.6.4 Setpoints and Ranges

No setpoints and ranges requirements are identified for the Valve/Pump Pits and Cover Blocks System.

4.1.6.5 Interlocks, Bypasses and Permissives

No interlocks, bypasses and permissives requirements are identified for the Valve/Pump Pits and Cover Blocks System.

4.2 Operations

The WFD Operations and Maintenance (O&M) Philosophy (HNF-4553) provides the project with constraints and guidance on system operations and developing operations procedures. The O&M Philosophy and the WFD O&M Concept (HNF-1939, Volume IV) are the primary bases for developing the Project Operations Plan. The O&M Concept is strongly influenced by the primary interfaces with the WTF. Significant penalties and /or increased costs may be incurred for failure to provide wasted feed of sufficient quality and quantity. Therefore, new facilities and upgrades of existing facilities are being designed such that there is minimal disruption of WFD due to system failures. System design and operation is optimized to support availability, reliability, and accommodate parallel processes where appropriate. Most of the concepts in HNF-4553 are related to keeping the WFD systems operating while supplying feed to the WTF and minimizing the shutdown time necessary for maintenance and repairs.

Systems are designed to be as reliable as possible with little or no preventive maintenance or testing required. The higher initial costs associated with more robust SSCs will be recovered through reduced down time, repairs, and avoiding contractual costs from the inability to provide feed to the WTF. The Operations Plan and Operations Procedures development are developed in coordination with interfacing projects to ensure a consistent O&M concept is implemented for all waste retrieval systems supporting WFD. The guidance for preparation and content of operations documentation is provided in HNF-IP-0842, Volume IV, Section 2.15 "Operations and Maintenance Planning Process" and on the River Protection Project (RPP) Systems Engineering Web Site.

Prior to each initial system startup, readiness to start-up will be verified to meet the intent and requirements of the PHMC procedure for facilities startup and readiness, RPP-PRO-55 "Facilities Start-Up Readiness" which implements DOE Order 425.1, *Startup and Restart of Nuclear Facilities.* The level and type of review will be conducted at the lowest practical level commensurate with the project safety risk.

4.2.1.1 Initial Configuration (Pre-Startup)

Prior to each transfer of waste through the waste transfer piping, any leak detection associated with that line will be verified to be within calibration and have had a functional test performed.

4.2.2 System Startup

New valve and pump pits will be started up as part of the approved transfer procedures for that specific tank and will be performed by qualified operators.

4.2.3 Normal Operations

New pits and cover blocks will be utilized in accordance with the approved operating procedures for each specific transfer. This will involve the performance of applicable Surveillance Requirements prior to and during all waste transfers.

4.2.4 Off-Normal Operations

Off-normal operations will be covered in the applicable operating and emergency response procedures for the specific transfer that is associated with a given pit.

4.2.5 System Shutdown

The pump and valve pits will be shutdown as part of their respective transfer system operating procedures.

4.2.6 Safety Management Programs and Administrative Controls

These controls will be defined as the design progresses.

4.3 Testing and Maintenance

4.3.1 Temporary Configurations

In order to perform some maintenance and testing activities, it may be necessary to align the system other than that for normal operations. Any situations requiring temporary configurations will be controlled via formal work procedures to ensure normal system configuration is restored when the maintenance or testing activity is complete. Under no circumstances will the system be allowed to operate with a temporary configuration until a formal temporary procedure change is written and approved. This procedure change process will ensure a USQ screening is performed and that the system will not be operated outside of its Authorization Basis.

4.3.2 TSR-Required Surveillance

The TSR Required Surveillance related to maintenance and testing of the Valve/Pump Pits and Cover Block systems is as follows:

- AC 5.22 (Transfer System Cover Removal Controls) requires that a program shall be maintained to control transfer system cover removal and specifies that operations "Establish procedures that identify required operator responses to the detection of a waste leak."

4.3.3 Non-TSR Inspections and Testing

Specific non-TSR inspections and testing for the Valve/Pump Pits and Cover Blocks System have not been identified. However, appropriate preventive and predictive maintenance will be performed to maintain the equipment in a satisfactory condition throughout the design life.

4.3.4 Maintenance

4.3.4.1 Post Maintenance Testing

Specific post maintenance testing activities for the Valve/Pump Pits and Cover Blocks System have not been identified. However, post maintenance testing will be conducted to ensure maintenance is properly performed, the identified/original deficiency is corrected, and the equipment is restored to an operational status. The rigor of post maintenance tests will be based on the extent of maintenance performed and the importance to plant/system safety and reliability. Post maintenance testing will be performed and documented in accordance with HNF-IP-0842, Volume V, Section 7.2, "Post Maintenance Testing", and HNF-IP-0842, Volume IV, Section 4.28, "Testing Practices Requirements."

4.3.4.2 Post Modification Testing

Specific post modification testing for the Valve/Pump Pits and Cover Blocks System have not been identified. However, post modification testing will be essentially the same as post maintenance testing. It is performed to ensure that the safety related functions of a system still perform satisfactorily after the system or equipment has been modified. Post Modification Testing is performed in accordance with the same guiding documents used for Post Maintenance Testing. The structural integrity of the modified pits and cover blocks will be verified by calculation.